THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK SEPTEMBER, 1906

Heating and Ventilating the First Day and Night Bank, New York

A Fine Type of the Mechanical Equipment of the Modern Office Building

Although but recently finished, the Day and Night Bank Building, at 44th street and Fifth avenue, New York, has already had fame thrust upon it, owing to the unusual conditions under which the bank is conducted. As its name indicates, it is never closed.

The bank itself occupies but a small portion of the building, which is eleven stories in height, and as an efficient system of ventilating as well as heating was desired in the banking rooms, it was necessary to install in this portion of the building apparatus which is almost wholly independent of the main heating plant.

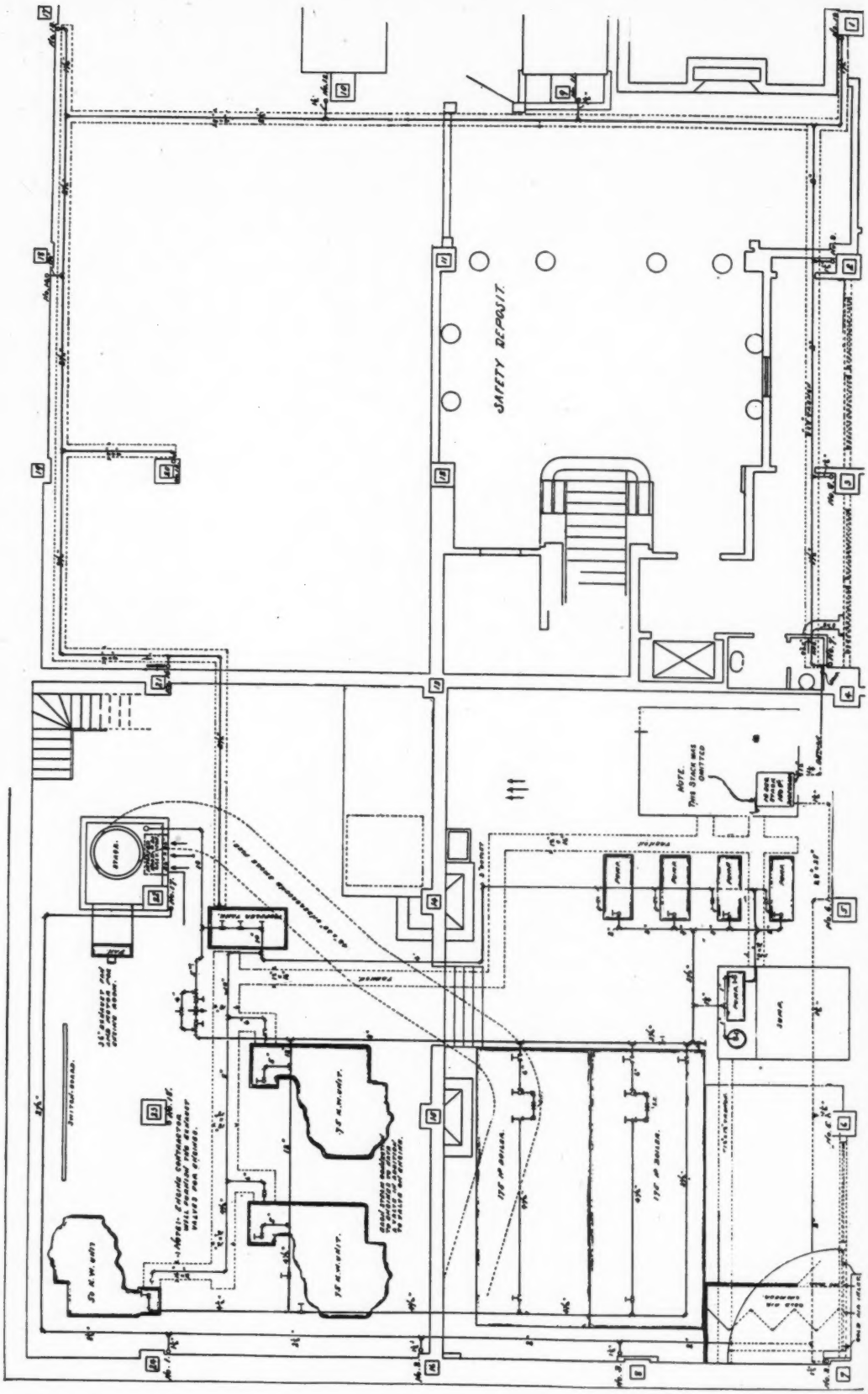
The building has a frontage of 65 feet on Fifth avenue and 105 feet on 44th street. The Day and Night bank occupies a portion of the basement and ground floors. In the basement the safe deposit vaults are warmed and ventilated by a forced fresh warmed and tempered air system, the tempered air being carried also to the main banking room where it serves as an auxiliary to a system of direct radiation. The direct radiators are grouped for purposes of temperature control. The rest of the building is heated entirely by exhaust steam from the power plant.

Two horizontal sectional water-tube boilers of 175 H. P. each, furnish the necessary power and heat to run the building. The boilers are connected to the smoke stack by an underground boiler flue.

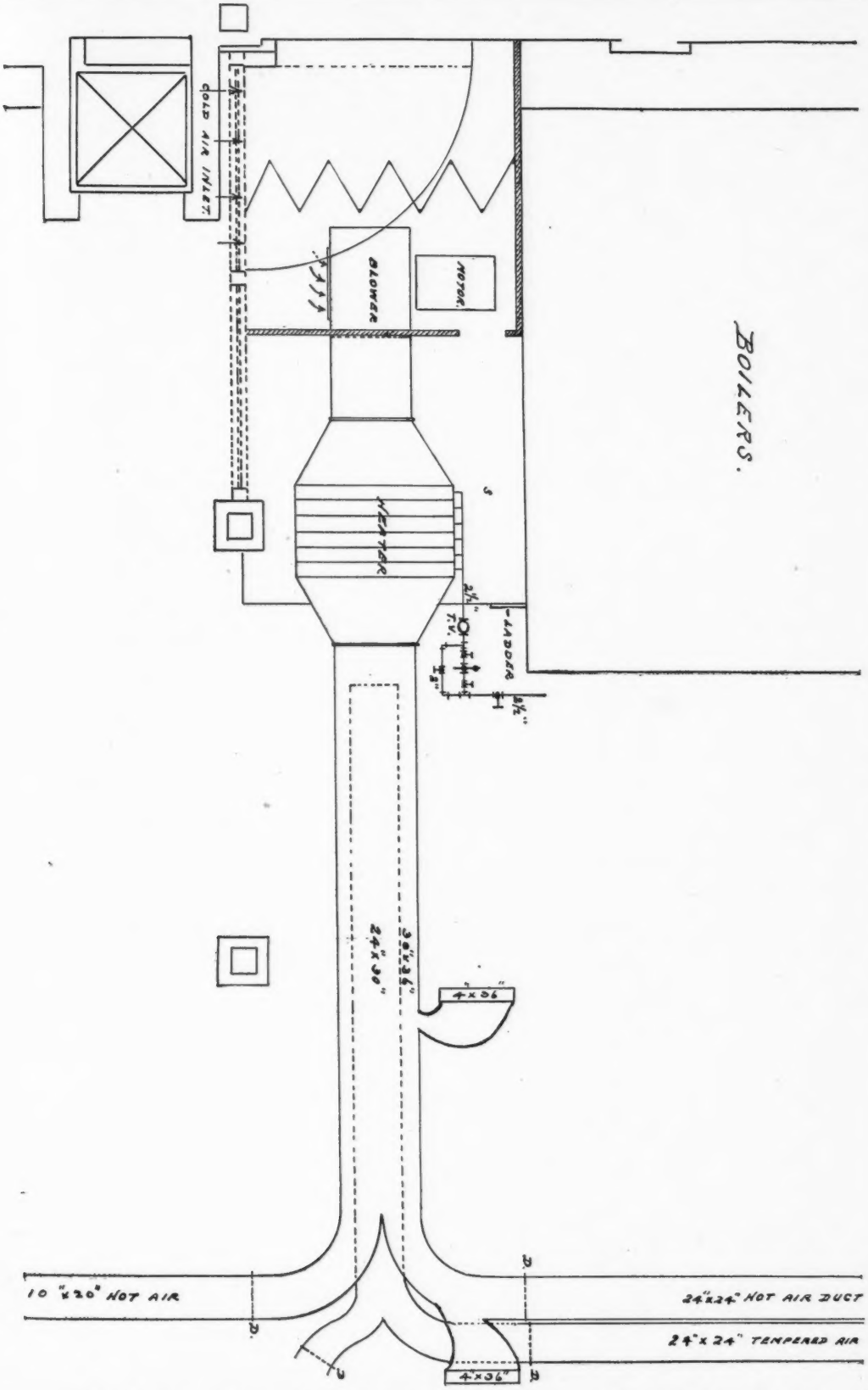
BOILER CONNECTIONS

The boilers are fed by two 6 x 4 x 6 pumps of the duplex type. There are also two 7 x 5 x 10 house pumps and one 5¼ x 3½ x 5 sump pump, all duplex. The boiler, feed and house pumps are connected up so that either one will perform the following duties: receive the house returns, pump to the tank on the roof, direct boiler feed, or to the fire line, and they are provided with the necessary interchangeable valves, so as to enable them to perform any of these duties. The suction from each of the pumps is carried in one main trunk line to the feed water heater, which is of 400 H. P.

A Ferguson combination muffler tank, pump governor, grease extractor and feed water heater is used, which serves to extract the oil from the exhaust steam and for muffling the exhaust line and for heating the feed water by exhaust steam. The pump governor, attached to this heater, is connected to the house returns, forming the usual water seal within the return tank portion of the muffler and operates to control the pumps automatically for the return of condensation from the heating system throughout. All drips running to this tank are by-passed and connected to the blow-off tank, so that the drips may run direct to the blow-off tank when the muffler tank is out of service. The sump pump is set on an iron grating in the sump and discharges to



PLAN OF PIPING IN BOILER AND ENGINE ROOM OF FIRST DAY AND NIGHT BANK, NEW YORK



VENTILATING APPARATUS IN THE DAY AND NIGHT BANK BUILDING, SHOWING ARRANGEMENT OF HOT AIR AND TEMPERED AIR DUCTS

on outlet in the house sewer. The suction of this pump is cross connected with the tank and pit so that either may be emptied. In addition to the sump pump, a steam ejecter is provided with 1½-inch discharge, controlled by a float valve which is connected to the blow-off pump discharge with check valves in connection.

A cylindrical boiler iron blow-off tank, 3 feet in diameter by 6 feet long is also set on the iron grating in the sump and is connected with the main blow-off pipe of the boilers. The tank is capable of sustaining a working pressure of 125 pounds and is provided with a spray connection of 1-inch pipe, the latter being a requirement of the city department. The condensing coil in the blow-off tank contains about 40 feet of 2-inch heavy brass pipe, connected to the water supply for the boiler feed pumps. This coil has a by-pass, so that the water can pass through the coil or direct to the pumps. A utility pump governor, connected to the tank and blow-off pumps, controls the steam supply to the blow-off

A hot water tank is provided for domestic use, containing a steam coil. The steam connections to this tank are taken from the exhaust main after it has passed through the muffler tank, with a by-pass and reducing valve from the live steam pipe.

POWER PIPING

The boilers, in addition to supplying power to the five pumps, ejector and feed water heater, also operate three electric engines. Starting from the steam nozzles of the boilers, 6-inch branches are run connecting into an 8-inch line which extends in the engine room and terminates in a 12-inch header. The connections to the engines are taken from the top of this header. There is also a 4-inch branch running from the boilers and connecting into a 6-inch auxiliary header, which extends into the engine room and connects with the end of the 12-inch header.

A second auxiliary, or pump header, is installed in the boiler room, to which separate connections are made with the 6-inch auxiliary and 8-inch main headers. From this second auxiliary header are taken all connections to the auxiliary apparatus.

In connection to each engine from the main header is placed a steam separator which is dripped to the muffler tank.

EXHAUST PIPING

The various branches of the exhaust piping are connected into one main trunk line which is run through a trench to the muffler tank and thence, with a 10-inch vertical exhaust, carried outside of the building to the roof. Here a full size connection is made for the heating system, the arrangement of the piping at this point being shown in the accompanying illustration.

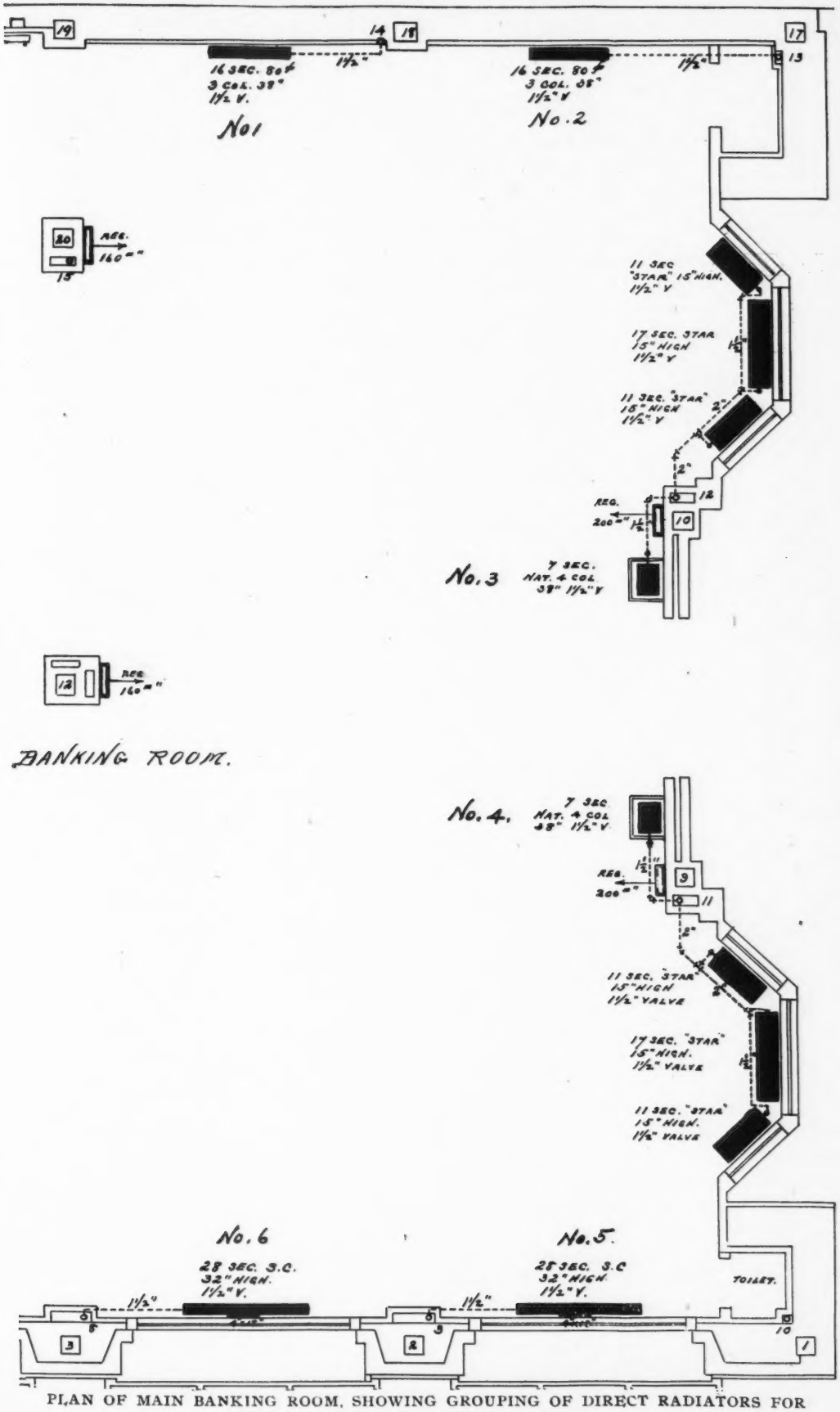
LOW PRESSURE PIPING

The low pressure steam piping is arranged with overhead steam mains run in the roof space and connecting to 19 drop risers which start generally 3 ½ inches to the tenth floor, 3 inches to the seventh floor, 2½ inches to the fourth floor, 2 inches to the second floor and 1½ inches to the first floor, continuing 1½ inches to the main return in the basement with a gate valve at each starting point in the roof space and a corresponding gate valve on the terminating point in the basement, where the return main is run to the pump governor at the muffler tank, and thence to the receiving tank.

This arrangement of the heating system is designed to give a circulation of steam through the 343 radiators in the building with one pound indicated pressure.

VENTILATION OF ENGINE ROOM

For the purpose of ventilating the engine room and of drawing the vitiated air from the Safe Deposit room, two 36-inch disk fans are installed at the points shown, the fans being operated by direct-connected electric motors giving a speed of 600 R. P. M. The discharge from each of these fans is connected to the ventilating space around the smoke stack by means of galvanized iron ducts. Arrangements are also made for a system of ventilation for the boiler and

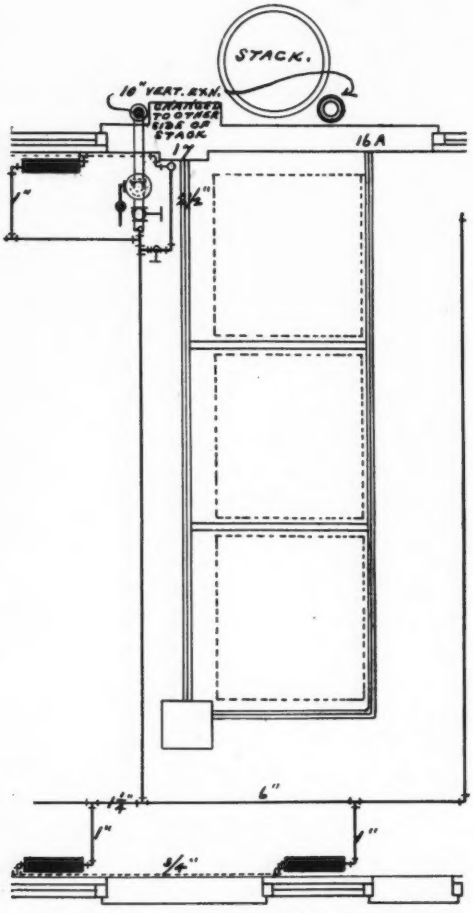


PLAN OF MAIN BANKING ROOM, SHOWING GROUPING OF DIRECT RADIATORS FOR PURPOSES OF TEMPERATURE CONTROL.

auxiliary apparatus room, which will be illustrated in our October issue.

HEATING AND VENTILATION OF THE BANKING ROOMS

Fresh warmed and tempered air is delivered to the banking rooms



CONNECTION AT EXHAUST HEAD WITH MAIN HEATING SYSTEM, DAY AND NIGHT BANK

through a 100-inch full housing blower fan, operated by a direct-connected electric motor of 8 H. P. This fan is connected to a six-section heater containing 2,700 feet of 1-inch pipe.

The cold air is taken from a window at the first floor level where it flows down through a galvanized iron duct into a fresh air room made of corrugated iron partitions. Here it is filtered by passing through cheese cloth, attached to frames set in galvanized iron upright stanchions. The cheese cloth is covered with wire mesh pulled taut.

The heater, blower and other apparatus is supported above the floor on three 8-inch I beams, resting at one end in the wall of the building. The other ends are hung from the ceiling girders by eyebolt hangers. Access is had to this platform by a ladder. After the ducts leave the boiler room and enter the safe deposit vaults, they are concealed behind the furring and in the false ceilings.

A 48-inch Wing disk fan, operated by a direct-connected motor of 2½ H. P., draws the vitiated air from the safe deposit vaults and banking room, as well as from the boiler room. It discharges into the open engine room immediately above the elevator machines.

HEATING SYSTEM CONTROLLED

The heating system in the bank is thermostatically controlled by seven thermostats operating 13 diaphram valves and 2 dampers. In the tempered air duct in the safe deposit vaults, one thermostat controls one double by-pass damper, and two thermotsats control two single dampers. In the main banking room, there are three thermostats controlling 12 radiators and one thermostat in the ladies' room, controlling one radiator.

The architect of the building is Henry Ives Cobb, of New York, and the steam plant was installed by Blake & Williams, of New York.

The Schoolhouse—Its Heating and Ventilation

By Joseph A. Moore,

Inspector of Public Buildings, State of Massachusetts

Air Supply for School Rooms (Concluded); Chimneys

V

(This Series of Articles Commenced in Our April, 1906, Number)

In placing the stack heater in the vent shaft it should be so located that the air for the combustion of the fuel and the draft for the heater are taken from outside the vent shaft.

In some of the earlier attempts at ventilation by using the stack heater in the vent shaft, the heater was placed entirely within the shaft and a manhole door was provided, through which to tend the heater. This arrangement did not give satisfactory results, as the supply of air for the combustion of the fuel was considerably lessened by the suction of the current of air passing up all around the hot surface of the fire-pot and reducing the draft through the grate, in some cases causing the fire in the stack heater to go out before the fuel was consumed.

IMPROPER METHODS AS TO VENT DUCTS

The practice of bringing a number of vent ducts in one common chamber in the attic of a schoolhouse, and placing in this chamber a quantity of steam pipes, is not to be recommended. It is much better and more economical to place the heating surface in the separate ducts and about one foot above the top of the vent opening from the room. In the first case we have only the lifting power of a column of warm air from the level of the steam-pipes in the chamber in the attic to the top of the vent stack, while in the latter case we have the lifting power of the longer column of warm air from the level of the radiating surface just above the opening at the schoolroom floor to the top of the vent stack, or, in other words, it would be a low chimney instead of a high one we depended upon to do the work.

A considerably less amount of heat will be required in the tall chimney than in the short one.

More even removal of foul air from the several rooms will be obtained when using separately heated vent ducts than when the common chamber in the attic is used.

WHEN AN EXHAUST FAN IS USED

When an exhaust fan is used, it is advisable to bring the separate vent ducts into one common chamber in the attic where the fan is located, and to control the flow of air from the several ducts into the common chamber by a properly arranged adjusting damper in each duct.

Theoretically, we can count the amount of air each separate duct should remove, but in actual practice the theoretical results will seldom be obtained on account of the constantly varying conditions of external temperature and wind; consequently, means for adjusting the outflow from each separate duct must be provided.

RADIATION FOR VENT FLUES

In actual practice 20 square feet of steam radiation surface in the vent flue from an ordinary fifty-seat schoolroom (28 x 32 x 12 feet) placed about one foot above the opening from the schoolroom, will give satisfactory results when the flue is straight and well built and when the vent flue has a cross-section of five square feet area (24 x 30 inches). If it becomes necessary for architectural reasons to carry a vent duct nearly horizontally for any considerable distance, either under the floor or over the ceiling, before it enters the perpendicular flue, this amount of radiation may be increased.

Better results are obtained when the steam pipes or radiators are placed with the lower part at the back of the vent flue and are inclined up and toward the front, than when an equal amount of radiating surface is placed around the sides.

The supply and return steam-pipes for supplying the vent-flue radiation should be placed at the back of the flue. If placed on the front side they will prevent the dampers being properly opened.

Where vent-flue heaters are made of steam pipes, one-inch or one-and-one-quarter inch pipes should be used and spaced so that they will cover the whole horizontal distance from one end to the other of the vent duct.

Where cast-iron radiators are used it is better to use radiators which are thin and wide and about 45 inches long (5 square feet per section), and space them with long nipples so that they will be evenly distributed across the full length of the duct. Do not use extended surface radiators in a vent duct, on account of the friction of the air passing over the projecting surfaces.

For the ordinary fifty-seat schoolroom (28 x 32 x 12 jeet) a vent flue 24 x 30 inches or 5 square feet, one square foot to each ten persons, has been found to be sufficiently large. A larger flue than this is not required, and in some cases has been found to be detrimental.

The opening should be at the floor level and should be longer than it is high; that is, the length should be 30 inches and the height 24 inches. A curved galvanized-iron damper operated with a chain and catch should be provided in all cases.

The proper location of vent openings was described under the head of "circulation of air."

CHIMNEYS

In designing a heating and ventilating plant it is of the utmost importance that the chimney should be of suitable size to furnish a good draft, as on the ability to maintain a good fire depends the successful generation of heat.

In many cases an otherwise well-designed plant has proved a failure because the chimney has not been of sufficient size to furnish suitable draft for the boilers or furnaces.

The architect who designs the building, as well as the heating contractor, should see that the chimney is properly designed and located.

The location of the chimney should be carefully considered, care being taken that the top is a sufficient distance above the highest point of the ridge, and that it is not placed in a position where the wind will strike on towers or projections and be deflected down on the top of the chimney in a manner that will destroy the draft, or, as in some cases, cause a reverse draft.

The writer has in a number of cases been called upon to remedy this defect, which would not have occurred had proper precautions been taken when the building was planned.

Under some conditions the action of the wind against a tower or roof has been such as to fill the boiler-room with gas, which, escaping through an open door in the boiler-room, has passed up into the building in a quantity sufficient to make the rooms above anything but comfortable or healthful.

Different writers give different rules for the size of chimneys.

One formula is: Let H=height of chimney, T = temperature of air entering chimney, t=temperature of air at top of chimney, and V=velocity in feet per second. Then $V=35.5\sqrt{H\ (T=t)}$.

A rule sometimes used is to allow one-eighth the area of the grate surface for area of chimney. This rule does not make any allowance for the varying heights of chimneys and is of doubtful utility.

Another rule is: Multiply the nominal horse power of the boiler by 112 and divide the product by the square root of the height of the chimney in feet. The quotient will be the required area in square inches at top of chimney.

William J. Baldwin gives as a rule: "Having the cubic feet of air to pass through a building in an hour, and warmed 100 degrees F., and requiring the chimney 100 feet high, divide by 500,000 and the answer is in square feet of cross-sectional area."

Thomas Hawley, late State Inspector of Boilers and Examiner of En-

gineers, and now principal of the "Hawley School for Engineers," used the following rule, which appears to be a safe one to follow:

"Make a chimney 81 feet high and of an area equal to the collective area of the boiler tube openings. If the chimney is higher than this, reduce the area in proportion as the square root of the height exceeds the square root of 81."

To find area of chimney, multiply the collective area of boiler tube openings by 9 and divide by the square root of height of chimney.

These last two rules are based upon the commercial H.P. and the evaporation of 30 pounds of water per hour. The coal to be burned is figured on this assumption, which is useful in determining whether the chimney is large enough, as in designing a new one, and may be used when either the area or the height is first settled upon arbitrarily, as is often the case when the architect designs a building with the chimney a given height above the ridge.

For larger powers the chimney should be higher than 81 feet, in which case the area can be less than the combined area of the boiler tube openings.

For ordinary schoolhouses two stories high, or two stories with a hall above the second story, where the area of the chimney is equal to the combined area of the boiler tube openings, satisfactory results have been obtained, and this may be considered a safe rule.

A chimney with too large a cross-sectional area may be the cause of door draft as well as one of too small area.

The height of a chimney is figured from the boiler grate to the top.

The intensity of the draft depends upon the temperature in the flue and the height of the chimney, and the amount of air moved is controlled by the area of the chimney.

The amount of air moved will vary directly with the area of the chimney for a given velocity of flow; but the velocity of flow increases only as the square root of the height.

Doubling the height of a chimney only adds one-half to its draft power.

A square chimney is of no more effective size than a round chimney of equal diameter; that is, it is only equal to the area of a circle inscribed within the square.

The friction of a column of air is figured to take an area from the chimney equal to the area all around two inches from the sides.

This should be considered in designing a small high chimney.

Within the limits of boiler practice the influence of temperature on a chimney draft is very small. It makes but seven per cent difference whether the temperature in the chimney is 300° or 550° F.

The space occupied by a pound of air increases rapidly with an increase of temperature, and as the velocity with which it moves out of the chimney does not increase as fast, the bulk increases faster than the ability of the chimney to handle it; consequently a temperature is reached at which the amount of air moved cannot be increased by that chimney.

A chimney that tapers at the top has its efficiency decreased.

A cap on the top of a chimney very materially decreases its efficiency.

A chimney flue should be as straight and as smooth on the inside as practicable.

All connections between the chimney and boiler or furnace should be made as straight and short as possible.

In designing a chimney it should be remembered: That the work a chimney will do should be compared upon the pounds of air it will handle.

The space occupied by a certain weight of gas increases directly as the absolute temperature. The absolute temperature is 460° added to the temperature shown by a Fahrenheit thermometer. The absolute temperature of the freezing point is $32 + 460 = 492$.

Increasing the temperature and bulk makes the air in the chimney lighter in weight and increases the difference in the weight of the column inside and a column of equal sectional area outside, and makes a higher column of the lighter air necessary to balance a given column of the colder air.

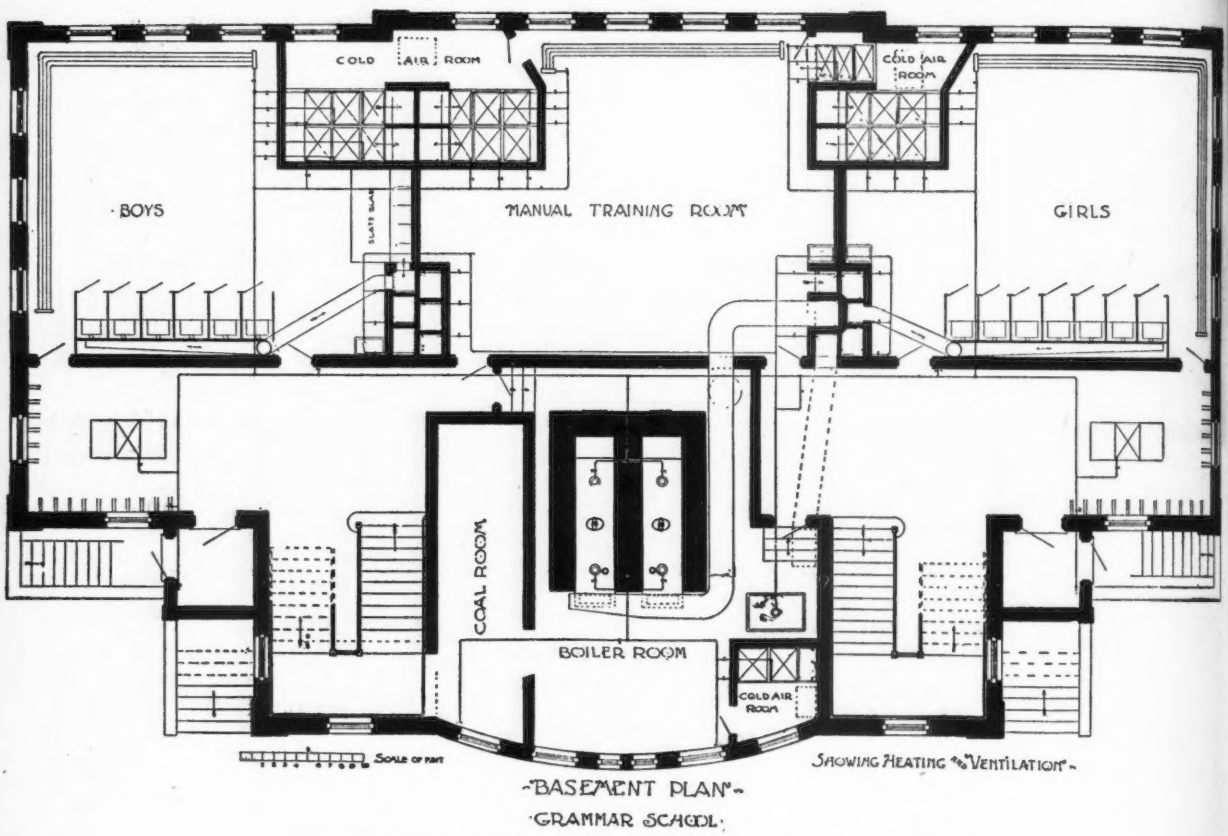
The difference in height of the two columns gives the air velocity due to this height. The difference in the height of the two columns is the moving force. Multiplying the difference in height of the two columns by 64.4 and extracting the square root will give the velocity.

The accompanying illustrations show the heating and ventilating plans for a typical grammar school building.

The building is constructed of light mottled brick with granite trimmings and slated roof, containing six class rooms, one recitation room, a manual training room, two teachers' rooms, two sanitary rooms, boiler room, coal room and three cold-air rooms, besides the corridors and stairways. There are four class rooms each 28 by 32 by 12 feet, two class rooms 29 by 32 by 12 feet, each accommodating forty-nine pupils. The basement is twelve feet high, except the boiler room and coal room, which are two feet deeper, or fourteen feet in the clear. The basement entrances are built with a bicycle run to take bicycles down to the places provided for them.

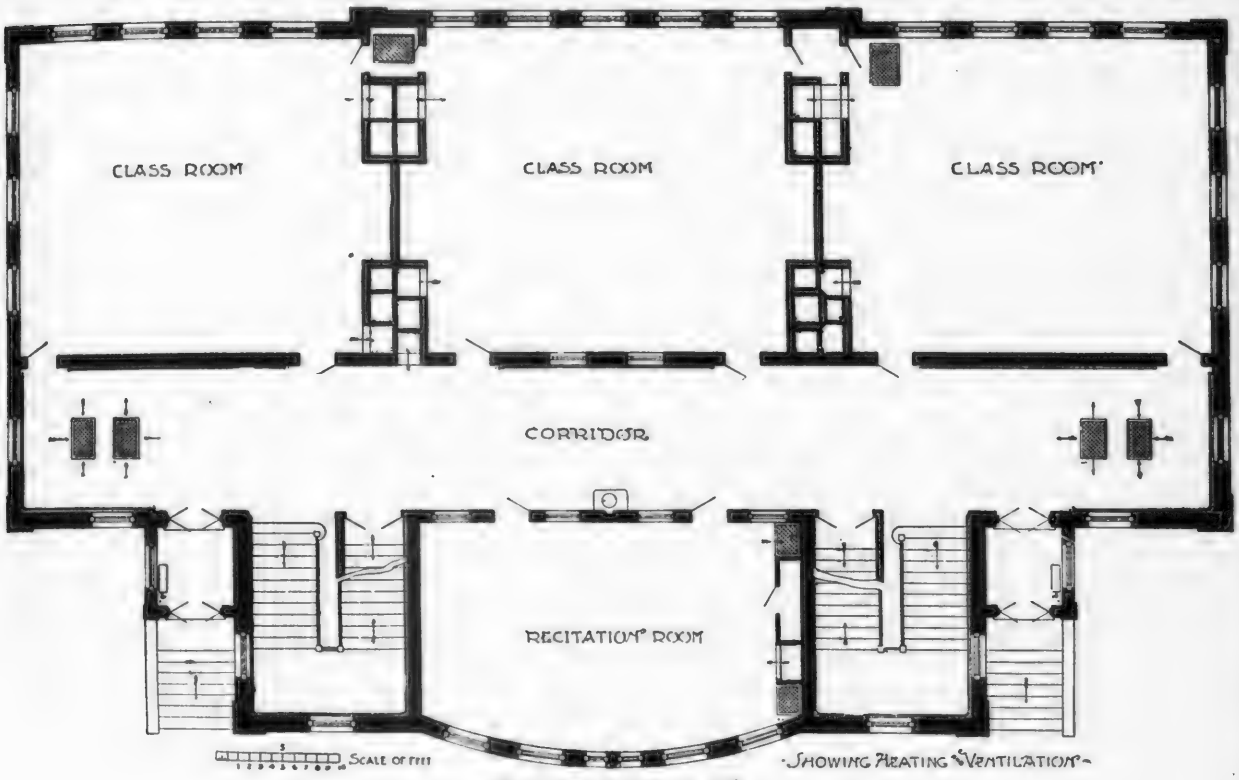
The corridors are fifteen feet wide, with walls of smooth water-struck brick without wood finish, being painted with light-colored gloss paint. Clothing is hung on special racks fastened to the walls, and there are two lines of 1¼-inch steam pipes below the racks and near the floor for drying and warming clothing in bad weather. Two foot-warmers are provided in the lower corridor. The heating is done by a two-pipe gravity return steam system.

The two teachers' rooms are heated by direct radiators, the manual training room in the basement by four lines of 1¼-inch steam pipe near the ceiling and also by indirect radiators.



BASEMENT PLAN OF TYPICAL GRAMMAR SCHOOL BUILDING

The boys' and girls' sanitary rooms are heated by four lines of 1¼-inch steam pipe near the ceiling, and ventilated through the sanitary fixtures, the seats having 4-inch diameter vents connecting with steam heated vent flues, with which the boys' urinal is also connected. Air is drawn into these rooms through wire grills in the bottom of the corridor doors, and the natural leakage around the windows and the removal of the foul air through



FIRST FLOOR PLAN OF TYPICAL GRAMMAR SCHOOL BUILDING

radiation is provided in each vestibule.

The warm air flues to the class rooms are 24 by 36 inches in cross section, and enter the rooms eight feet above the floor through openings covered by a wire grill 36 by 30 inches. Each warm air flue is fitted with a mixing valve or damper for regulating the temperature of the incoming air.

An adjusting damper is also provided for each warm air flue for regulating the amount of air for each room, as this will vary according to the height of the flue or its location with regard to the prevailing winds.

Each vent flue, except the sanitary, is provided with a galvanized iron damper for regulating the outflow of air.

In each class room vent flue there is twenty square feet of radiating surface of 1¼-inch steam pipe made into the form and placed as indi-

the seat and urinal vents will properly ventilate these rooms and prevent odors from passing up and into the building.

In the floor of the first story are three rotating registers for rotating the air through the indirect radiators when the schools are not in session. The air for the foot-warmers is rotated from the corridor at all times. A vent is provided in each corridor, both corridors being vented into the same shaft. Direct

DETAILS OF HEATING AND VENTILATION IN TYPICAL GRAMMAR SCHOOL BUILDING

cated in the section showing the vent flues.

The vent from the recitation room is carried down and through a galvanized iron duct (No. 24 gauge iron) on the basement ceiling to the brick vent flue for this room, which has twenty-five square feet of steam pipe radiation, placed about on a level with the floor of the first story.

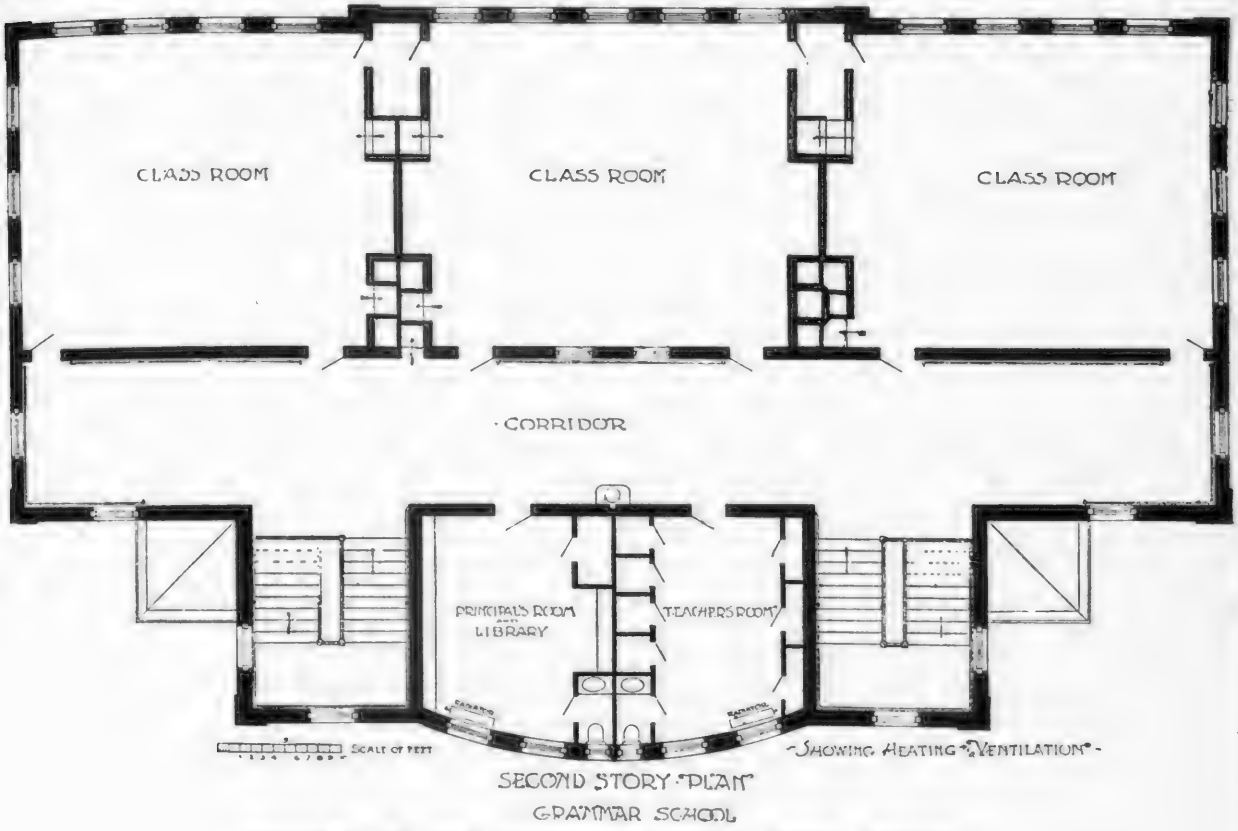
Each sanitary vent has twenty square feet of the same kind of radiation.

The building is heated by two horizontal tubular boilers of 27 horse power each, and a cast iron sectional boiler for heating the vent flues when the larger boilers are not in use in moderately warm weather. These sectional boilers are generally designated "summer boilers." The boilers are so piped and valved that either or all of them can be used as desired.

The recitation room has 300, the two middle class rooms 380, and the four corner class rooms 400 square feet of cast iron indirect radiation of twenty square feet per section, made into three sections for each stack, separately piped and valved, in order that the amount in use can be regulated according to the weather. The vent flue heaters are separately valved and piped.

Hand bowls and faucets are provided in the first and second story corridors and cast iron sinks in the boys' and girls' sanitary rooms, bowls and sanitary fixtures in the teachers' rooms in the second story. Mirrors are placed over the bowls and sinks for the pupils' use and in the teachers' toilets.

Hose is to be provided for use in the basement. It is advisable to install a stand pipe and hose in the basement and each corridor for use in case of fire.



SECOND FLOOR PLAN OF TYPICAL GRAMMAR SCHOOL BUILDING

Sections are presented showing the arrangement of the indirect radiators, mixing valves and warm air flues, the foul air flues, heaters and dampers, adjusting dampers, rotating register and windows in the cold-air rooms, clothing racks and the catches for holding the chains for the mixing dampers and vent dampers.

Mechanical Plant of an Ohio Office Building

Use of Air Washers for Overcoming Smoke Nuisance in the Dollar Savings and Trust Company's Building, Youngstown, Ohio

In many sections of the Middle West, the smoke from soft coal has an important bearing on the ventilation of buildings and the use of air washers to free the air of soot, as well as of other particles, is being tried with success. This is an interesting feature of the plans illustrated herewith, for a bank and office building at Youngstown, Ohio.

In this building mechanical ventilation is provided for the basement and banking rooms, and it will be noticed that both the supply fan and the exhaust fan are directly connected to the same motor.

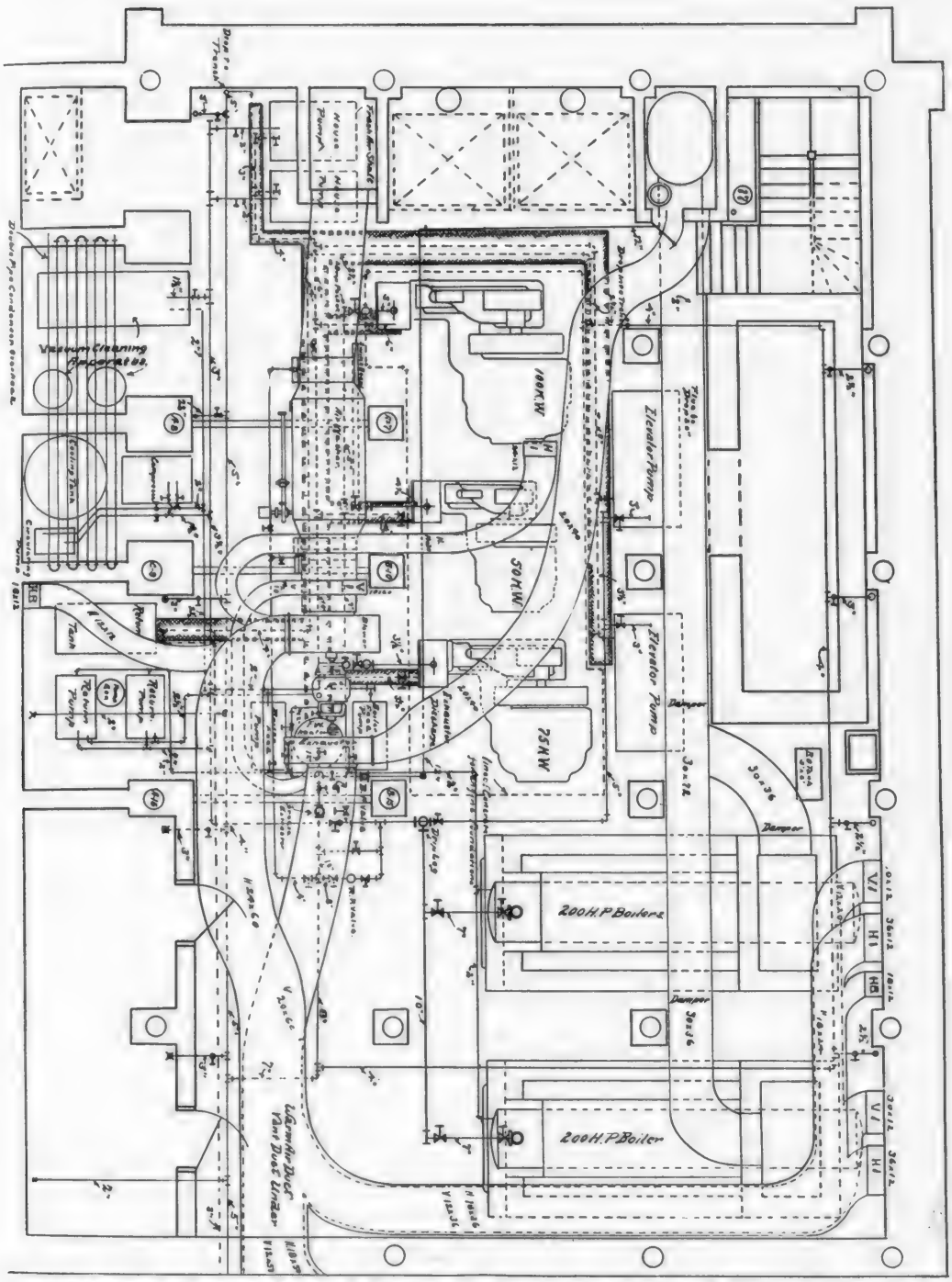
The building is 12 stories in height and provision has been made for a thoroughly modern mechanical plant. The main system of heating is by direct radiation and the water of condensation is returned by gravity to the receiving tank in the engine room and thence is pumped automatically back to the boilers. The apparatus is arranged to use exhaust steam from the engines, pumps, etc., but it also has an automatic reducing valve for admitting live steam at a low pressure. The piping is arranged on the single pipe plan and the Paul Vacuum System is provided, so that the entire apparatus will fill and circulate at a pressure below the atmosphere.

The reproduction of the basement plan shows the general arrangement of the apparatus. The two boilers are water tube, each of 200 H. P. capacity and designed to carry a working pressure of 180 pounds per square inch. The smoke breeching is connected over the boilers and thence to the stack, with a damper of the butterfly type, operated with an automatic damper regulator. The two boiler feed pumps are each 6x4x6 inches and the two return pumps 5½x3½x5 inches. A 10-inch Bundy grease separator, with drip connection to sump is placed in the main connection to the heating system.

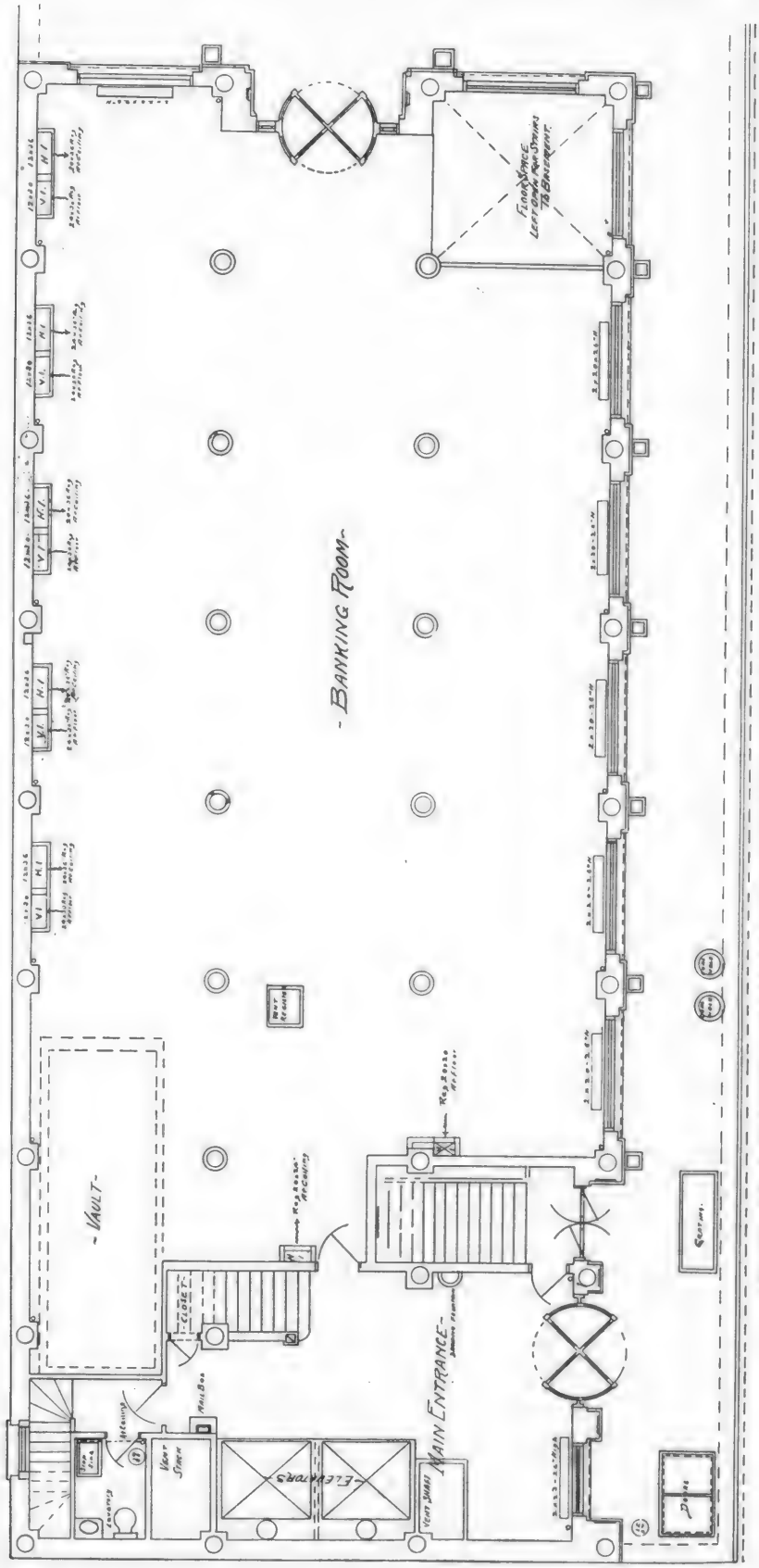
The feed water heater has a capacity of 300 H. P. Other details of the equipment include back pressure valve in the main exhaust pipe near the heater, a 5x8 Kieley '98 reducing valve in the live steam connection to the heating main, with by-pass; also, Bundy horizontal steam separators attached to each supply pipe to the generator engines. The receiving tank is 3x6 feet, and attached to the return pumps and relieving tank is a Kieley pump governor with equalizing pipe to tank and heating main. Steam traps are provided on the high pressure drip line, on the feed water heater, on the grease extractor, with by-passes in each case, and on the returns from the hot water tank. The blow-off tank is 6 feet long and 30 inches in diameter, fitted with brass cooling coils and is connected to blow-off into the sewer.

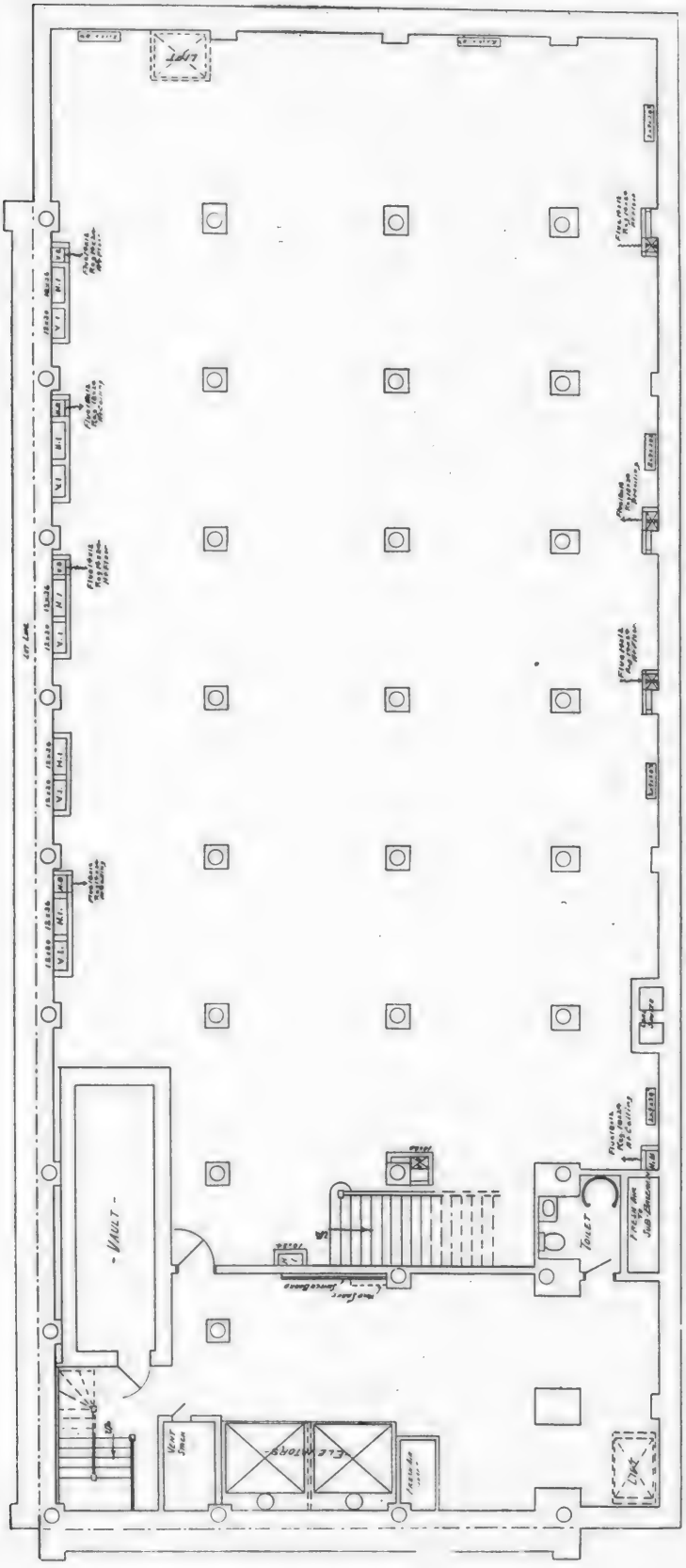
PIPING

From the steam outlets on the boilers, 7-inch branches are run to a 10-inch header. Where the drop leg is indicated in the boiler room, the main is carried down to the required level and all branches taken from that point. The exhaust pipe is run in an exhaust trench under the engine room floor to the oil separator and heater. At the heater arrangements are made to by-pass the exhaust steam if desired. From the heater the exhaust pipe runs on the basement ceiling and thence to an exhaust head on the roof. The main exhaust, after it leaves the last en-



CELLAR PLAN, DOLLAR SAVINGS AND TRUST COMPANY'S BUILDING, YOUNGSTOWN, OHIO, SHOWING INSTALLATION OF AIR WASHER AND SUPPLY AND EXHAUST FANS DIRECT-CONNECTED TO SAME MOTOR


BANKING ROOM
VAULT
MAIN ENTRANCE
ELEVATORS
CLOSET
MAIL BOX
VEST. DOOR
VEST. SHORT
FLOOR SPACE LEFT OPEN FOR STEAM TO CIRCULATE
RECORDS
RECORDS
VAULT
VAULT
VAULT



PLAN OF BASEMENT IN DOLLAR SAVINGS AND TRUST COMPANY'S BUILDING, YOUNGSTOWN, OHIO, SHOWING VENTILATING SYSTEM

gine, is 12 inches in diameter to the exhaust head and steam heating main.

The steam supply for all pumps and auxiliary apparatus is taken where shown from the main steam pipe, and the exhausts are connected to the main exhaust pipe in the trench.

A 1½-inch high pressure steam drip pipe is also carried in the exhaust trench into which all the steam pipe and steam separator drips are run. This pipe follows the trench to a high pressure trap near the return tank, into which it will discharge, although it is so arranged that it may discharge into the sump in case the return tank should be shut off. The exhaust drips are of two classes. The portion between the engines and oil extractor drain into a trap discharging into the sump. The oil extractor is drained into the same trap. The portion after leaving the oil extractor is drained into the heater. The exhaust head, and the bottom of the vertical exhaust pipe, as well as the coils in the hot water tank, are all drained through a trap into the return tank.

The three electric generators are operated by three side crank engines, under an initial steam pressure of 125 pounds and having a capacity of 150, 120 and 80 H. P., respectively. The generators are direct current, multipolar, compound wound, engine type, arranged for direct connection to engine. They are of 100, 75 and 50 kilowatts capacity, respectively, and operate at 250, 275 and 275 R. P. M.

HEATING AND VENTILATION

As stated, the system of heating is by direct radiation, with mechanical ventilation for the basement and banking room. The ventilating apparatus, including fans, motor and air washer, is set on a platform in the engine room. Fresh air is taken through an intake running from the roof and thence through a sheet iron duct to the tempering coil and supply fan. The tempering coil consists of five sections of Buffalo sectional base fan system heater, each section to have four rows of pipe deep and to be 3 feet long by 5 feet 10 inches high, the total coil containing 1,385 lineal feet of 1-inch pipe. The pipes are set staggered. The air passes thence through a Buffalo air washer, designed to handle 7,500 cubic feet of air per minute and, at this capacity, the loss of pressure due to the resistance of air washer and the separator is not to exceed 2/10 of 1-inch water gauge. The dimensions of the washer are 6 feet high by 3 feet 4 inches wide by 7 feet long. The washer is guaranteed to remove not less than 94% of all solid material contained in the air and to completely remove all traces of free moisture of the spray from the air current. When used for cooling, it is to give a final difference of temperature between air and the cooling water not to exceed 20% of the initial difference in temperature. The supply fan is a full housed, right hand top horizontal discharge, having a 50-inch blast wheel and delivering 10,000 cubic feet of air per minute at 350 R. P. M. against a total pressure of ¾ ounce.

The exhaust fan is also a full housed 50-inch steel plate fan, with a right hand bottom horizontal discharge. This fan is designed to deliver 7,500 cubic feet of air per minute at 350 R. P. M. against a total pressure of ¾ ounce.

The motor operating the two fans is 7½ H. P. multipolar, direct connected. It will be noticed that the foul air duct is carried from the exhaust fan through the engine room to the smoke stack.

There is a total of 17 steam risers and 17 air risers in the building, the latter being ¾ inch in diameter throughout.

The plant was designed by Mr. Burton P. Hall, of New York, and the architects of the building are Messrs. Owsley and Boucherle, Youngstown, Ohio.

The New England Foundrymen's Association held its September meeting at the Exchange Club, Boston, September 12 last, when an address on "Recent Moulding Machinery and Methods" was given by Mr. E. H. Mumford, of Philadelphia.

Practical Points on Ventilation

By Charles L. Hubbard

The amount of air required to maintain any given standard of purity in buildings can be very easily determined, provided we know the amount of carbonic acid given off in the process of respiration. It has been found by experiment that the average production of carbonic acid by an adult at rest is about .6 cubic feet per hour. If we assume the proportion of this gas as 4 parts in 10,000 in the external air, and are to allow 6 parts in 10,000 in an occupied room, the gain will be 2 parts in 10,000, or, in other words, there will be $\frac{2}{10,000}$=.0002 cubic feet of carbonic acid mixed with each cubic foot of fresh air entering the room.

Therefore, if one person gives off .6 cubic feet of carbonic acid per hour, it will require .6÷.0002=3,000 cubic feet of air per hour per person to keep the air in the room at the standard of purity assumed, that is, 6 parts of carbonic acid in 10,000 of air.

The following table has been computed in this manner and shows the amount of air which must be introduced for each person in order to maintain various standards of purity:

TABLE I

Standard parts Carbonic acid in 10,000 of air in room.	Cubic feet of air required per person: Per minute.	Per hour.
5	100	6,000
6	50	3,000
7	33	2,000
8	25	1,500
9	20	1,200
10	16	1,000

While this table gives the theoretical quantities of air required for different standards of purity, and may be used as a guide, it will be better in actual practice to use quantities which experience has shown to give good results in different types of buildings. In large auditoriums, where the cubic space per individual is great, and in which the atmosphere is thoroughly fresh before the rooms are occupied, and the occupancy is of one, two or three hours' duration, the air supply may be somewhat reduced from the figures given above.

The following table represents good modern practice and may be used with satisfactory results:

TABLE II

Air supply per occupant for	Cubic feet Per min.	Cubic feet Per hour.
Hospitals	80 to 100	4,800 to 6,000
High Schools	50	3,000
Grammar Schools	40	2,400
Theaters and Assembly Halls	25	1,500
Churches	20	1,200

When possible, of course, the air supply to any given room should be based upon the number of occupants, but it sometimes happens that this information is not available, or the character of the room is such that the number of persons occupying it may vary, as in the case of public waiting rooms, toilet rooms, etc.

In instances of this kind, the required air volume may be based upon the number of changes per hour. In using this method various considerations must be taken into account, such as the use of the room and its condition as to crowding, character of occupants, etc.

In general, the following will be found satisfactory for average conditions:

Use of Room.	Changes of Air per hour.
Public Waiting Rooms	4 to 5
Public Toilets	5 to 6
Coat and Locker Rooms	4 to 5
Museums	3 to 4
Offices, Public	4 to 5
Offices, Private	3 to 4
Public Dining Rooms	4 to 5
Living Rooms	3 to 4
Libraries, Private	3 to 4
Libraries, Public	4 to 5

It often happens that architects' plans give only the dimensions of an auditorium or school room without stating the seating capacity. In cases of this kind it is safe to assume about 15 square feet of floor space per occupant, which includes aisles, platform, etc. Sometimes in the case of audience halls the space allowed per occupant is made as low as 10 or 12

square feet, but the larger figure given above is more common.

HOW TO USE AN ANEMOMETER

Measurements of the total air supply to a building by an anemometer are commonly made at the fresh air inlet windows, while the supply to an individual room is measured at the register.

For approximate results the anemometer may be moved slowly across the opening in either vertical or horizontal parallel lines, so that the reading will be made up of velocities taken from all parts of the opening. Readings one minute in length are usually sufficient for rough work. When more accuracy is desired, the opening should be divided into squares, the number depending upon the degree of accuracy required. Readings are then taken at the center of each square, and the average of all the readings used in determining the final result. If the opening is comparatively small, the division into squares can usually be made by the eye, but for those of larger size it is better to stretch light twine across, attaching it to tacks driven into the casing.

When air is delivered to a room through a wall register, the velocity is much greater at the top than at the bottom, and if sufficiently high there may be a reverse or outward movement through the lower part. In computing the average of several readings, the negative or reverse readings must be subtracted from the total. For approximate results, as when roughly adjusting the air-flow to different rooms, a single reading may be taken while holding the anemometer at or slightly above the center of the register. In the case of vent or discharge openings the velocity is more nearly equal over the whole area, but for accurate results the same methods of measurement should be used, as already described for the inlets.

When taking measurements of air-flow at grilles and registers, the anemometer should be held about 4 inches from the face of the fretwork, as at this distance the jets of air issuing through the various openings become practically united in a solid stream or current having a sectional area equal to the over-all or gross area of the register face. If more accurate results are required, the register should be removed and measurements taken in the unobstructed opening.

LOCATION OF AIR INLETS AND OUTLETS

The location of the air inlet to a room depends upon the size of the room and the purpose for which it is used. In the case of living rooms in dwelling houses, the registers are placed either in the floor or in the wall near the floor; this brings the warm air in at the coldest part of the room and gives an opportunity for warming or drying the feet if desired. In the case of school rooms where large volumes of warm air at moderate temperature are provided, it is best to discharge it through openings in the wall at a height of 7 or 8 feet from the floor; this gives a more even distribution as the warmer air tends to rise and hence spreads uniformly under the ceiling; it then gradually displaces other air and the room becomes filled with pure air without sensible currents or drafts. The cooler air sinks to the bottom of the room and can be taken off through ventilating registers placed near the floor. The relative positions of the inlet and outlet are often governed to some extent by the building construction, but if possible they should both be located in the same side of the room.

The vent outlet should always if possible be placed in an inside wall else it will become chilled, and the air-flow through it will become sluggish. In theaters and churches which are closely packed, the air should enter at, or near, the floor in finely-divided streams, and the discharge ventilation should be through openings in the ceiling. The reason for this is the large amount of animal heat given off from the bodies of the audience; this causes the air to become still further heated after entering the room, and the tendency is

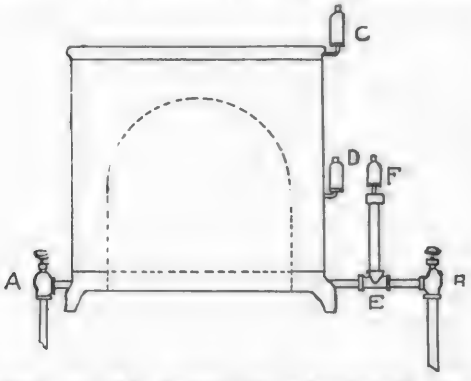
to rise continuously from the floor to ceiling, thus carrying away the impurities from respiration as fast as they are given off.

All audience halls in which the occupants are closely seated should be treated in the same manner when possible. This, however, cannot always be done, as the seats are often made removable so that the floor can be used for other purposes. In cases of this kind part of the air may be introduced through floor registers placed along the outer aisles, and the remainder by means of wall inlets the same as for school rooms.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Hot Water Radiators Used in Steam Heating

At the Chicago meeting of the Heating Engineers, Secretary William M. Mackay gave an interesting description of an experience he had some years ago in the use of hot water radiators for steam heating. "I set up a hot-water apparatus," said Mr. Mackay, "for testing hot water boilers. The radiators we used were base and top and they answered our purpose, and then were left in place for heating the building. Later a steam boiler was installed and we undertook



HOT WATER RADIATOR ARRANGED FOR USE AS A STEAM RADIATOR

to test it on these same hot water radiators. We had reports during the day and the report of the night watchman every hour as to the pressure maintained and the radiators were reported to be warm. We found that the entire center of this radiator was not heated. Both sides and top of the radiators were warm but the central portion remained perfectly cool except for what little condensation trickled down. The radiator was fed at *A* (See Sketch). The return *B* being of the same size. We placed air valves at *C* and *D*. The only way I could remedy the trouble was to insert a tee at *E* and extend a pipe from *E* half the height of the radiator, placing an automatic air valve at the upper end *F*. I was then able to extract 85 to 90 per cent. of the air that was in the radiator."

Durability of Radiator Nipples

The topic at the Chicago meeting on "the durability of different kinds of nipples for connecting radiator systems relative to the material and the capacity to withstand shock and strains, also the effects on boiler connections" has aroused so much interest that we take pleasure in presenting Mr. James Mackay's revised remarks on the subject.

Mr. Mackay said: "The radiator nipples that have been used by manufacturers are cast iron, malleable iron, drawn tubing or stamped nipples. The stamped sheet metal nipple stamped out of a flat plate has not been found to be the very best, but it has compensated for this in expansion and contraction. I am referring more especially to push or slip nipples.

"We make a nipple of seamless drawn tubing slightly tapered and put into the radiator hubs. They draw together very well and seem to have all the elements of durability. It is more rigid than a stamped nipple on account of its thickness, but has enough elasticity. We have also nipples made of malleable iron which seem to be very good. One manufacturer has used them made of brass tubing, upset to a slight taper and drawn together; they would seem to be practically indestructible. No galvanic action takes place and the brass compensates for expansion and contraction. Some threaded nipples are made of heavy cast iron. I do not think they will stand a severe shock, although they do stand ordinary shocks that are met with in moving and disconnecting. They are made heavy and strong with thick, deep threads and they are put together with Manila gaskets, drawing the two faces up against the gasket. In this way the nipple is used more as a staybolt than anything else, perhaps. I am speaking of radiator nipples. Some of them are right and left threaded. Others referred to are push nipples.

"The trouble with nipples, as I find them, is that you may devise a nipple and coat it with any kind of non-corrosive material and seemingly it will answer the purpose; it takes a number of years to determine whether it will be durable or not. A great many nipples after being used five or six years are found to be rusted out. That gave rise to the use of a thicker one. My idea is that a malleable iron push nipple is as good a nipple as can be devised."

THE HEATING AND VENTILATING MAGAZINE

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NO event in the heating trade during the present year has aroused more interest than the recent reorganization of the boiler manufacturers of the country. This organization comprises in the neighborhood of forty manufacturing firms and has set sail under the title of The Boiler and Radiator Manufacturers' Association. Oddly enough, the regulation of prices is not, except indirectly, the cause of bringing the manufacturers together again, the primary reason being undoubtedly due to the present policy of the National Association of Master Steam and Hot Water Fitters. This organization as is generally known, has been endeavoring for some time to make arrangements with manufacturers individually looking towards more satisfactory trade conditions, and the matter has been pushed to such a point that the manufacturers have seen the wisdom of organizing themselves so as to deal as a body with the various proposals.

The rubber stamp has played a prominent part in the developments, a stamp used by Master Fitters on their orders making it a condition that defective parts of boilers be replaced without charge. The Manufacturers' Association has now appointed a trade relations committee, made up of the representatives of six of the largest boiler and radiator manufacturers in the country. This committee has already held one meeting with the trade relations committee of the Master Fitters' Association at the latter's headquarters.

AT this meeting little more could be done than to obtain at first hand the various propositions of the Master Fitters, especially those outlined in its recent trade agreement, with the idea of reporting back to the Manufacturers' Association before making formal reply. In this way the two associations will be dealing man to man, as it were, and the advantage of organization will be equalized. The first conference with the Master Fitters, which took place the eighteenth of this month, was followed the next day by a meeting of the manufacturers at the Hotel Imperial, in New York, at which it was stated that the matters already taken up would undoubtedly lead to a number of further conferences in the near future.

THOUGH impossible at present to tell the outcome of the negotiations, it can not be doubted that they present a rare opportunity to both the manufacturers and the contractors to get together on a common sense basis. Subjects, for instance, such as that of credits, could properly engage the attention of these bodies and very easily result in more actual betterment of trade conditions

than any amount of discussion upon matters which it is apparent will not, at least for a long time to come, if ever, result in a unanimity of opinion. In the present temper of the business world, it is not to be wondered at that business men are wary of committing themselves definitely to any proposition concerning the propriety of which there is the slightest doubt in their own minds, and this situation only emphasizes the desirability of effecting, while the opportunity is open, such things as a credit system about which, from a legal standpoint, there can be no question from any quarter.

THE importance of this matter of credits may be judged when it is said that the majority of boiler manufacturers prefer, as a rule, to do business with the smaller steam fitters and plumbers than with the more important power and heating contractors in the large cities, for the reason that they get paid more promptly. It is no uncommon thing, for instance, for a large contractor to take 90 days or perhaps longer to settle his accounts, and where these accounts run, as they usually do, into many thousands of dollars, it constitutes, in the aggregate, an enormous and largely needless burden the manufacturer has to carry. Of course, this is not to be taken to mean that the contractor is directly to blame for this well-nigh universal dilatoriness. He is dependent, in many cases, upon the builder or the owner, and the value of their patronage is generally sufficient to prevent his pushing them. But here is where some constructive work of the first order can be done through conferences of manufacturers and contractors, and it is to hoped this feature of present-day trade conditions will not be overlooked in the discussion of what appear to many to be comparatively less important matters.

NOTHING but praise has reached us of our proposal, announced last month, to issue monthly records of the weather conditions in New York City and in other representative localities. This plan will be carried out in connection with a supplementary series of articles in which, it is hoped, many new points will be presented that are not now generally considered in heating work. It should also serve a useful purpose in aiding the designing engineer to keep tab on the operation of his plants. The first chart, appearing in the October number, will be a record of the weather in Manhattan for the present month.

WHILE the contracting branch of the steam fitting trade has been remarkably free from labor troubles during the present year, the manufacturers have not been so fortunate. The strike of the Iron Moulders' Union, which went into effect early in the year, has become the largest disturbance in the foundry industry in this country. From four to seven thousand men have been on strike since the first day of May, having gone out in the first instance on account of the refusal of foundrymen to sign closed shop agreements with them. In something like 125 shops we are informed the strike has been successfully resisted, and these shops are now operating wholly with independent moulders. The Foundrymen's Association reports that the independently operating shops are getting out practically their maximum output.

The Warming of Steamships

By Charles R. Honiball, Liverpool, England

II

(Concluded from the August, 1906, issue.)

The general arrangement of what is known as the "balance tank" system, is shown diagrammatically in Fig. 11. This system has been installed on a large number of yachts, and with satisfactory results, by a well-known Southampton firm. The installation consists of a vertical hot-water boiler *B*, fitted in the stokehold, a feed supply cistern, *F*, *T*, and the balance tank, *B*, *T*, the latter being so placed that the bottom of the tank stands about 2 feet above the highest radiator. The fore and aft circulations are generally separate, as shown. The forward circulation is connected direct with the boiler, and is arranged on the same lines as the "Reck," excepting that the pipes are larger, and kept uniformly the same diameter throughout the circulation, and for a similar size job would be about 2 in. The vertical flows and returns to the radiators are about 1 in. The aft circulation has not, as a rule, got the same good run as the forward, and, moreover, generally carries the greater part of the radiation surface. To insure a good circulation aft, the main flow-pipe is first carried to the balance tank, then brought back to the stokehold, and distributed in the same manner as the forward circulation, and returns to the boiler.

In some small installations the feed tank, *F*, *T*, is dispensed with, and the balance tank made to serve both purposes. In this case the tank must be open to the atmosphere, and it is usually constructed with conical anti-splash plates, as shown in sectional view. With the closed balance tank, the feed supply is usually connected to the bottom of the tank with a siphon, or directly onto the return-pipe from tank. These tanks are from 30 to 50 gallons capacity, and are made of ⅛ in. galvanized iron plates.

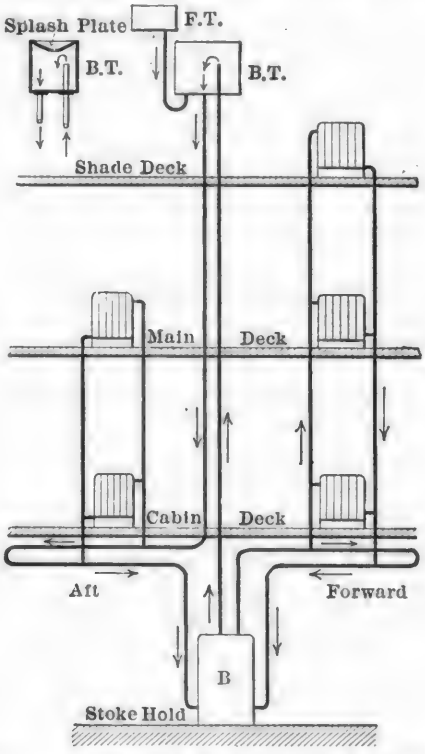


FIG. 11. BALANCE TANK SYSTEM, USED LARGELY ON YACHTS

HIGH PRESSURE HOT WATER SYSTEM ON THE STEAM YACHT "RIONNAG-NA-MARA"

High pressure hot-water systems have also been employed, one notable installation being that fitted on A. G. Pirie's steam yacht "Rionnag-na-Mara," by a well-known Liverpool firm. The advantages of this system for marine work are obvious. The vigorous circulation set up in the heating pipes entirely overcomes the prejudicial influences of level differences, pitching, rolling and other effects peculiar to marine plants. Radiators may be dispensed with, and a small piping only employed, thus introducing the necessary heating surface into the various rooms in a way to be entirely unobstructive, and without taking up valuable space—a most important consideration on board ship.

The heater or boiler is placed in the stokehold, from whence the circulating pipes are carried fore and aft to the various apartments to be warmed. The pipes are about 1¼ in. external diameter, connected by hydraulic joints with right and left hand threads. The pipes being so small there is no difficulty in passing through partitions and water-tight bulkheads, and in making same watertight. The whole apparatus being closed, the loss of water is extremely small; an open top supply cistern is not, therefore, required, and the difficulties in connection therewith are eliminated.

CIRCULATING HOT WATER BY MECHANICAL MEANS

The employment of mechanical means to assist the circulation of hot water through the pipes and radiators of a warming installation has but rarely been employed on board ship. Quite recently, however, such a system has been installed on several well-known private steam

yachts. The general features of these installations follow similar lines to those already described for yacht work, and the only portion of the apparatus requiring description, is shown in Fig. 12. It will be seen from the illustration that the increased velocity of the water is obtained by the action of a propeller or rotary pump fitted in the return main. The pump may be rotated by an electric motor, or, as shown, by a steam turbine. When the latter is employed, the steam supply is

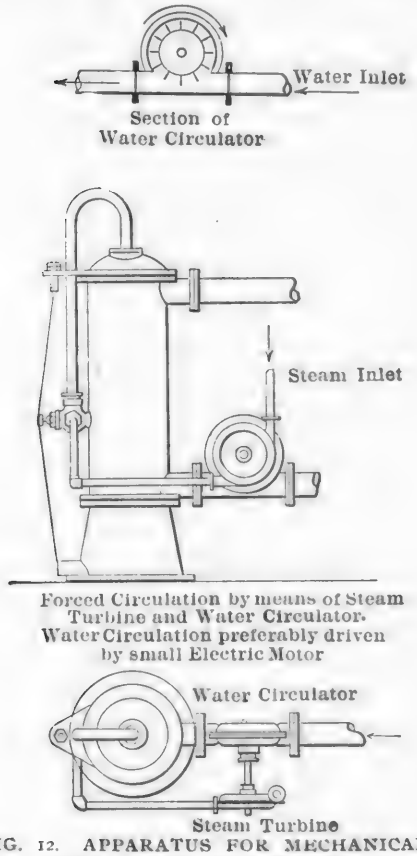


FIG. 12. APPARATUS FOR MECHANICALLY CIRCULATING HOT WATER IN HEATING SYSTEMS

arranged to pass through the turbine before entering the heating coils or tubes of the heater.

Warmed Air System

The system of warming and ventilating the living spaces of vessels by the distribution of warmed air, is now being largely adopted on the vessels of the royal navy and mercantile marine. The installations now fitted follow very similar lines to those erected on shore. The air heaters or thermal tanks, as they are most generally called, consist of a battery of steam-heated tubes or coils enclosed in an iron casing. The fresh air is drawn from shafts, which rise only a few feet above the upper deck and have open mouths protected only by a hood to keep out rain and spray, and is forced by steam or electrically driven fans through the casings, heated tubes, trunks and shafts, into the compartments to be ventilated and warmed, the air being delivered about the ceiling level. A central installation for the whole ship is not favored. Those now fitted on many of our liners and warships consist of a number of complete units placed in various parts of the vessel, in proximity to, but outside of, the compartments which they are intended to ventilate and warm, and arranged to work independently of each other or in combination. Such an arrangement does away with the necessity of large air-trunks running through water-tight bulkheads, a most important consideration, especially in warships, where even watertignt doors have been eliminated.

Though the fan system of ventilation has been employed on H. M. warships for over thirty years, the distribution of warmed air for warmth and ventilation has but recently been adopted by the Admiralty. The battleship "King Edward VII" was the first ship to be so fitted. The system has proved effective and satisfactory, with the result that steam-heating systems are to be installed on all new ships.

USE OF SIROCCO FAN ON NEW BATTLESHIPS

On the latest battleships, the thermal tanks are placed on the sleeping or inhabited decks, and the air conducted to the crew spaces, every officer's cabin, the ward-rooms, and captain's and admiral's quarters. The installation consists generally of 6 to 8 thermal tanks, with electrically driven fans, usually 12½ in. diameter and of the "Sirocco" pattern. Each fan runs at a speed of 1,000 to 1,500 revolutions per minute, and delivers about 1,400 cubic feet of air. In the larger battleships open fires are still burnt in the ward-room, gun-room and admiral's apartments for cheerfulness and homelike comfort. No open fires or stoves are in the officers' cabins, but many of them have electric heaters as well as the warm air supply trunks.

NEW CUNARD LINERS EQUIPPED WITH WARM AIR SYSTEMS

On the new Cunard liners "Caronia" and "Carmania" the warm air system is employed for warming and ventilating the living quarters of the second and third class passengers, and also the crew spaces. The installation on each vessel is divided into twelve complete units or thermo-tanks. Each of these was designed to efficiently warm and venilate about 60,000 cubic feet. The fans are driven by electric motors, each of 4 H P. The thermo-tanks are fitted on the pper deck, the fresh air being drawn from shafts opening on the topmost or boat deck, and delivered through galvanized iron trunking to the various rooms, dining-saloons,

etc. By a suitable arrangement of valves on the conections to and from the thermo-tanks, the air may be exhausted from the compartments to the atmosphere; or may be circulated in the compartments through the heater, thereby raising the temperature very rapidly; and air at atmospheric temperature may also be delivered direct into the ventilating trunks without passing through the heater.

A general arrangement of one of the ventilating thermo-tanks fitted on the "Caronia" and "Carmania" and many other vessels, is shown in Fig. 13. It will be seen from the illustration that the heater is a cylinder with tubes passing from end

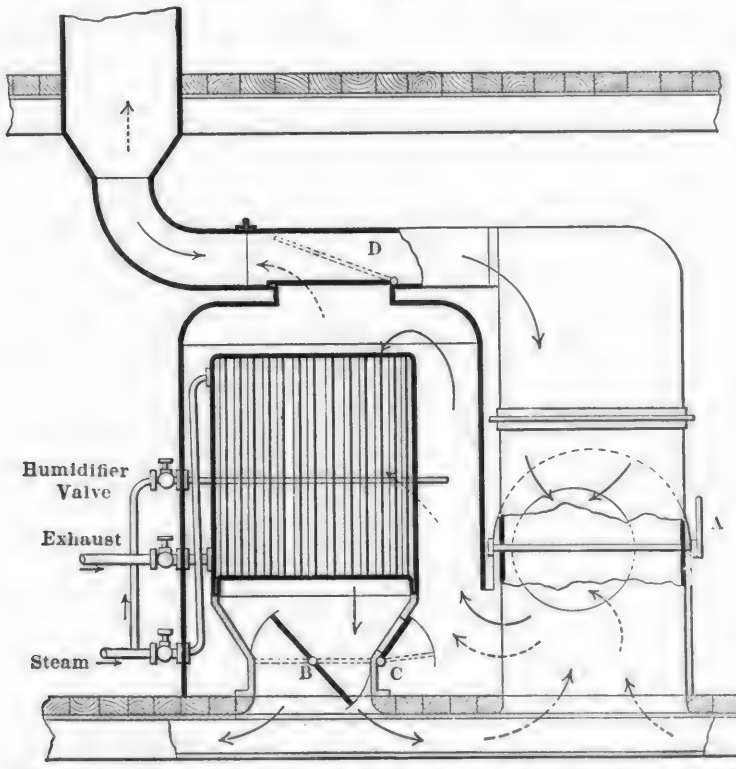


FIG. 13. GENERAL ARRANGEMENT OF ONE OF THE VENTILATING THERMO-TANKS FITTED ON THE "CARONIA" AND "CARMANIA"

to end enclosed in an outer casing to which the discharge branch of the fan is connected. The heating or cooling medium circulated in the cylinder, round the tubes through which the air to be heated or cooled passes on its way from the fan to the compartments.

DIAGRAM FIG. 13—OPERATION OF AIR VALVES

Exhausting.	Supplying.
Valve *A* is open to trunk.	Valve *A* is open to atmosphere.
Valve *B* is shut.	Valve *B* is open.
Valve *C* is shut or open.	Valve *C* is shut or open.
Valve *D* open to heater.	Valve *D* closed to heater.

In order to show the working of the apparatus when supplying or exhausting air, the different valves have been arranged and lettered A, B, C, D, respectively. The arrows shown by full lines denote the direction of the air when supplying, and the arrows in dotted lines the direction of the air when exhausting.

The heaters are warmed by steam from the main boilers, the steam inlet valve being placed at the top, and the condensed steam drain at the bototm of the casing. The pressure of the steam is reduced to about 30 lbs. per square inch, and a relief valve is fitted to blow off at 80 lbs. to 100 lbs. The air is humidified by admitting steam in a fine spray by means of small needle holes in a copper hoop surrounding the heater.

SUPERIOR EFFICIENCY OF WARM AIR SYSTEMS SHOWN BY TESTS

The efficiency of this system, as compared with the system of heating by steam pipes, will be seen from the diagram, Fig. 14, giving the results of comparative trials made by the Russian officers of the volunteer fleet on the S. S. "Kostroma" and T. S. S. "Moskva," belonging to that fleet. The "Kostroma" was fitted with the warm air system, and the T. S. S. "Moskva" with the steam pipe system. Particulars of the spaces warmed, heating surface, etc., are given in the following table:

COMPARATIVE TRIALS OF WARMED AIR AND STEAM SYSTEMS ON SHIPBOARD

	Main Deck "Kostroma."	Main Deck "Moskva."	Lower Deck "Moskva."
Volume of compartment in cub. feet.....	14803	20309	20930
Heating surface in sq. feet.....	208	202	191
Number of persons in compartment.....	246	262	284
Number of times air is changed per hour....	6.9	7	8¾
Cubic feet air per person per minute	7	9	11
Time taken for temperature to rise 5 degs.	7 mins.	2 hrs. 5 mins.	1 hr. 35 mins.
" " " " " 10 "	15 mins.		
" " " " " 15 "	25 mins.		
" " " " " 20 "	40 mins.		

Electric Heating

The convenience and utility of electricity for heating purposes has long been appreciated on land, but the peculiar facility with which the electric current can be employed on shipboard for heating surface has only during the last few years been fully recognized and appreciated. It is not too much to say that every characteristic of the electric heater which commands its use on shore is emphasized with peculiar force in marine work, where compactness, weight, cleanliness, convenience and safety are points of utmost importance.

On all the latest trans-Atlantic vessels of the Cunard, White Star, Hamburg-American, North German Lloyd and other well-known passenger lines, the upper deck and other important staterooms, chambres-de-luxe, and, in many cases, the saloon-officers' cabins, etc., are warmed by electric heaters. On H. M. warships, cross-channel and other passenger vessels, yachts, etc., electric heaters are fitted in place of, or auxiliary to, steam or other warming systems.

The warming of rooms can be accomplished either by radiant or convected heat. With the former method heating is effected by the agency of glow-lamps, and with the latter by resistances working at comparatively low temperatures.

In the glow-lamp type the filaments of the lamp are raised to an exceedingly high temperature, and the electric energy is transformed mainly into radiant heat, only a small portion being given off by conduction and convection—hence, the name "radiator." In the non-luminous type the resistances are either bare or embedded in enamel, and are raised to a comparatively low temperature, which heats the air in contact with them, thereby setting up convection currents in the air. They are generally designated as "radiators," though the term is a misnomer. They should rather be named "convectors" or "air-warmers." Compared with the glow-lamp radiator, a convector may be likened to a closed stove, steam or hot-water coil as against an open fire. The difference between these two methods of heating is, therefore, a very wide one.

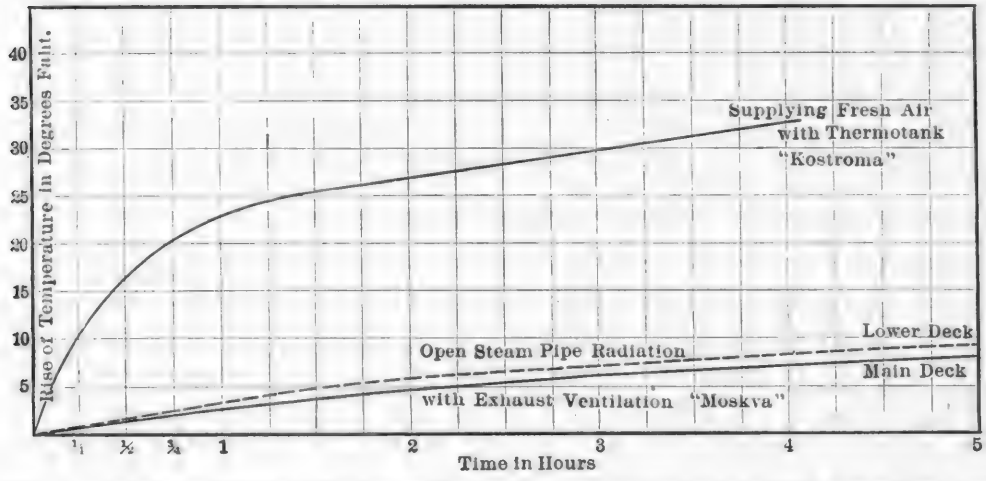


FIG. 14. DIAGRAM GIVING THE RESULTS OF COMPARATIVE TRIALS OF WARM AIR AND STEAM PIPE SYSTEMS MADE ON THE RUSSIAN SHIPS "KOSTROMA" AND "MOSKVA"

ELECTRIC RADIATORS OF CONVECTOR TYPE UNIVERSALLY USED

Radiant heat only raises the temperature of a body which is opaque to heat waves; it passes through the air without heating it in the slightest, and only causes a rise of temperature in the air by heating objects that offer any opposition to its passage through them—these in turn heating the air in contact with them by conduction. Heat waves are unaffected by air curents, and the glow-lamp radiator is suitable, therefore, for warming oneself out-of-doors in balconies, etc., or for quickly warming any portion of one's body. On the other hand, the heat generated in the resistances warms the body of the convector, and the air is heated by direct contact with the hot surfaces. Convection currents are consequently set up in the neighboring air, which quickly equalizes the temperature throughout the room in which the convector is placed. Convectors are therefore, under normal conditions, far more effective than glow-lamp radiators for heating rooms, provided the temperature of the resistance material is not high enough to materially affect the humidity of the air. On shipboard, electric radiators of the convector type are universally employed, those fitted in the saloons, etc., being usually illuminated by glow-lamps for cheerfulness.

FIG. 15. MODERN TYPE OF ELECTRIC CONVECTOR USED ON SHIPBOARD

DESCRIPTION OF ELECTRIC HEATERS

During the past few years many improvements have been made in the design, construction, durability and efficiency of electric heaters, thus greatly extending their usefulness. A short description of several of the heating elements of electric heaters will be of interest.

One form of glow-lamp radiator consists of lamps about 10 in. long and 2½ in. in diameter. The contained carbon filament is about 1-16 in. in diameter and 13 in. long, being bent in the middle to form a single loop, each lamp consuming about 250 to 300 watts, with usually four lamps in each radiator.

In many forms of convectors a special kind of wire is used as the resistance material. In one type the wire is first formed into a spiral coil and then wound upon porcelain insulators; whilst in another, the wire is wound directly upon the insulating material. In many other types the resistance wire is embedded in enamel

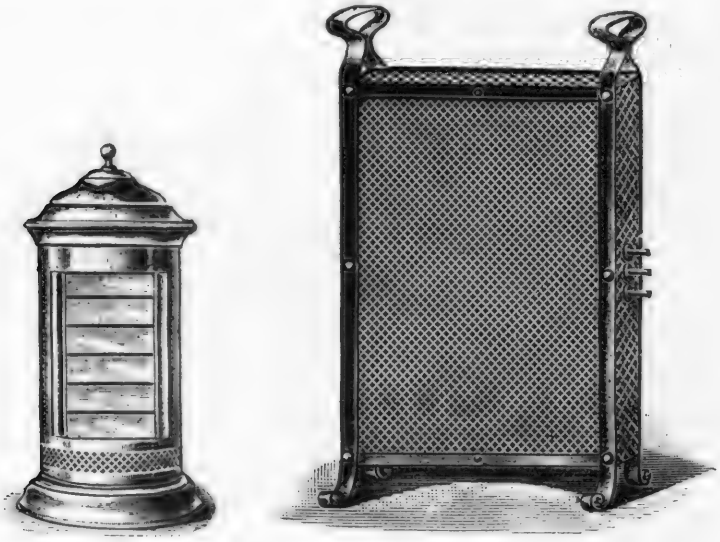
FIG. 16. ANOTHER TYPE OF ELECTRIC CONVECTOR

of a nature similar to that used on enameled ironware, the base being generally cast or sheet iron. In another well-known system the elements are composed of various metals deposited on thin strips of mica. The mica strip is efficiently insulated by another strip of mica placed above it, and the whole is mechanically protected by being inserted in a thin metal

case, which has practically no capacity for heat.

When used in ordinary air warmers, such as convectors of radiators for heating a room, the elements are fixed in metal frames which connect them in parallel, and by this means should one of the elements give way, the working of the others is not affected in the slightest. The elements can be made of any resistance from 5 to 100,000 ohms. When employed in air warmers, a standard form of element is used, usually arranged to consume 70 watts. This loading is equivalent to a temperature of about 250 degs. C. When used for other purposes, such as the boiling of liquids, the elements are much more highly loaded, the loading going as far as 250 to 400 watts, whilst in the ordinary form of flat-iron, much larger elements are employed, consuming from 450 to 800 watts. Time and space will not permit the description of other efficient forms of heating elements.

Figs. 15 to 18 illustrate a few of the electric convectors, etc., now installed on board ship.



FIGS. 17 AND 18. TYPES OF ELECTRIC CONVECTORS

SAME RULES GOVERN PLACING OF ELECTRIC HEATERS AS THOSE USING STEAM AND HOT WATER

Electric heaters should be installed on the same principle as steam and hot-water heaters. They should be properly placed, and for average conditions 1 watt per cubic foot should be distributed by as many radiators as possible. One heavy current radiator will not give such good results as several smaller ones taking the same current collectively. Although it cannot be claimed that electrical heating is cheaper than heating by other systems, still the many advantages which it possesses, especially for marine work, must be taken into consideration. The ease with which the electric wire may be installed in comparison with the expense and difficulty of supplying steam and water connections is a strong point of advantage. Portability, lightness, freedom from disagreeable odors, cleanliness, small cost for repairs and maintenance as compared with other systems, are advantages far outweighing the slight additional cost of an electrical installation.

To illustrate the progress of electrical heating, it will interest you to know that on many of the large vessels of the White Star Line—for instance, the "Celtic"—over 200 convectors are installed in the first-class staterooms. On the "Amerika" there are approximately 100, including four electric fireplaces. On each of the Cunard steamers "Caronia" and "Carmania" there are about 40, six of these being of elaborate design, and illuminated, and placed in the saloon and writing-room.

Though steam and water systems have been the principal methods of heating in the past, and will doubtless be for many years to come, yet electrical heating will prove a formidable rival, any reduction in the price for current, which is possible, making a considerable difference. Progress demands that we move with the times, and it behooves every member of this Institution to look into this new system of heating, which offers such an attractive field for yacht, liner and residence work.

Air Filters and Humidifiers—Past and Present

Only in the last ten years, at the most, have engineers begun to realize the importance of the quality as well as the quantity, of the air supplied for ventilating purposes. It is only in the last five years, it may be conservatively estimated, that 75 per cent. of the heating and ventilating engineers have seen fit to provide all large installations of any importance with some sort of an air filter. These, in their first types, can be called nothing but "contraptions," but then they served the purpose to a certain extent, according as the janitor of the building saw fit to take care of them and keep them in adjustment and cleaned out.

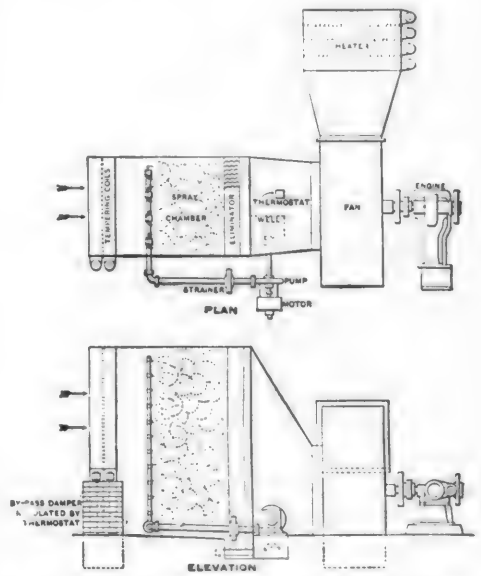
The humidity of the atmosphere may be gauged by two methods. One is by learning the actual amount of moisture present per cubic foot of air. This is called the "absolute" humidity, and the weight of the water is given in grains. The other is by finding it relatively—that is to say, the per cent. of moisture that the air is holding as a vapor when compared to the amount that it could hold at that temperature if it were saturated. This is called the "relative" humidity.

Since the air is capable of holding more moisture as the temperature is raised, if the moisture be not supplied the "relative" humidity is lowered, and since the humidity that is normal to the body is between 50 and 75 per cent., it is obvious that when rooms are heated by steam or hot water in the winter, when the humidity is normal outside, the temperature of the warm air inside the building the air is much drier than it should be for the maintenance of physical health. Easy calculation shows that the average room in winter is drier than a desert. The sensation of the body in an atmosphere lacking in humidity is that of coolness, and hence it is necessary to raise the temperature a corresponding amount above what is called for by the body if the humidity were regulated to the proper point.

In large buildings, where the volume of air that must be heated and maintained at an agreeable temperature is great, these few extra degrees called for by the lack of humidity require an amount of coal during the winter months that has surprised those who have installed humidifying apparatus and noted the difference. But the cost of coal saved by the employment of a humidifier is a small matter compared with the healthful conditions necessary in a hospital, for instance, or as compared with the need of perfect regulation of the humidity in a lithographing establishment, drafting room or library.

SCREEN AND COKE FILTERS

After many years of experimenting, air washers and humidifiers have been developed that not only regulate the humidity of the atmosphere to the finest degree but thoroughly cleanse the air of all impurities, such as soot, dust, and bad gases. Older types of filters which have been used by different engineers with varying success are made of cheese-cloth. Some have preferred to make the filter in the form of a screen placed across the inlet duct, while others construct it in the shape of numerous bags of cloth, in order to get more surface in a smaller space. Both of these schemes fail in so far as any regulation of the humidity is concerned and, in addition, they take an enormous amount of floor space due to the size of



BUFFALO AIR PURIFIER AND HUMIDIFIER

the filters required, because of the friction of the air in passing through the meshes of the cloth. As they are not automatic, their construction has, in some instances, served to make them germ breeders, and if not frequently cleaned they are apt to become stopped up.

Another form of air filter is a coke screen over which a trickle of water is allowed to pass, with the idea that the water will keep the apparatus clean and that if the air can absorb any of the water, so much to the better. The coke is held in place by two wire screens. Some objections to the coke screen are that when constructed it occupies too much floor space, requires constant attendance and renewal, as it does not clean itself through the agency of the water trickle. By test it was found that the air passing did not absorb as much of the water as had been hoped, and so this

plan was dropped. The next form that the filter took was that of an endless belt of burlap which was kept wet by dipping into a tank of water. The air was caused to pass through the belt, which was moved over a system of rollers by power. By this method the air did absorb more of the water than in the coke screen, but the apparatus had the old inherent objections of no regulation, too much room occupied, lack of automatic operation, and also mechanical difficulties which could not be overcome.

SPRAY FILTERS AND HUMIDIFIERS

In the Buffalo air washer and humidifier the air is brought into direct contact with water spray. After leaving the intake grating the air is led directly to the air washer and there is sprayed by closely spaced nozzles ejecting each between one and one-half and two pounds of water per minute, in the direction of air travel. The air then encounters the eliminator plates, which remove the free moisture from the atmosphere, allowing it to retain only the amount dictated by the regulating devices to keep the humidity at the proper point. The first portion of the eliminator baffle plates presents to the water merely a water-covered surface, and contact with this is what removes the solid particles that may be in suspension in the incoming air. The second portion of the plates is provided with vertical gutters which break the continuity of the water film and prevent its being blown from the farther edge of the plates and on into the fan and up into the building. The free moisture is removed by these gutters and runs with the solid matter removed from the air into a settling tank beneath the washing chamber. Here there is provision for removing the accumulation of dirt, and then the water is pumped again to the spraying nozzles by a small brass centrifugal pump. The resistance to the air passage by the baffle plates is less than one-tenth of an inch water pressure, and hence is negligible. The design of the nozzles is unique, it may be added, because the water is atomized by centrifugal force acquired by its rotative action acquired by the direction of its passage in leaving the nozzles. The settling tank is usually built in a concrete foundation for the washing chamber, it being found that this answers well and is both inexpensive and neat.

Another office that air washers are capable of filling during the summer is that of an air cooler. This is an important application for theaters in particular and, of course, is used so in all installations during the warm weather. The Buffalo Forge Company has made installations and guaranteed that the final difference of temperature between the air and the water shall not exceed 20 per cent. of their initial difference in temperature. This, it will be seen, indicates a very efficient method of cooling and one which is very inexpensive when compared with any other in use at the present time.

CONTROL OF HUMIDITY BY USE OF THERMOSTAT

The humidity control of the air passing on to the ventilating system through the agency of a thermostat is an interesting feature, since a thermostat is a heat-indicating instrument and not a humidity indicator. The ability to do away with the humidity-indicating instruments is an important step, for they are often unreliable in the long run, though very sensitive when in proper working order. It has been discovered, after experiments covering several months, that the amount of moisture that a given body of air will absorb during a given length of time in contact with a body of water is more dependent on the temperature of the water than on the temperature of the air. It is this fact that enables the humidity control to be through the thermostat. When the thermostat indicates that the temperature of the air it is in contact with is changing, then it shows that the absolute humidity must change in order to keep the relative humidity constant. The temperature of the spraying water is, therefore, changed by means of a steam jet over which the thermostat above mentioned has control.

A New Steam Trap

The V-V Steam Trap, for coils and radiators, also for drip pipes on separators, steam mains and exhaust pipes, is a simple but useful device that has been placed on the market by the Vacuum-Vapor Company, Moline, Ill. The expansion plates operate on the principle of a swinging check valve. The plates have a pivot bearing directly opposite the valve seat. They fit loosely on this bearing, which allows the plates to adjust

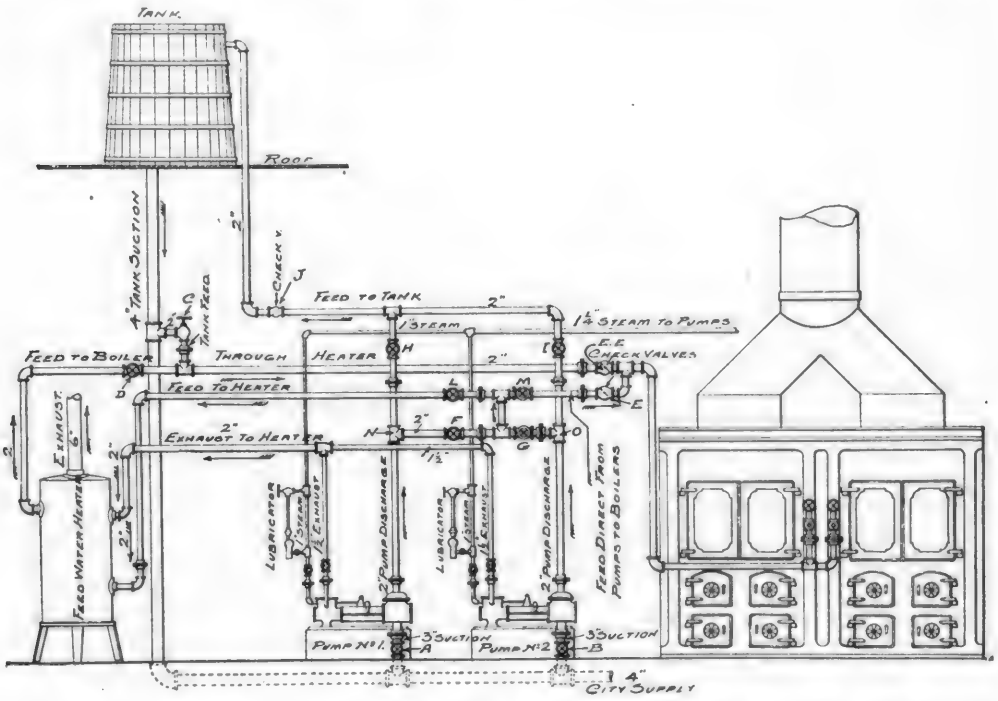
V-V STEAM TRAP

themselves to the valve seat when they close. Special metals are used which do not set or buckle. The special construction of the expansion plates gives an exceptionally large movement. This device is 1½ inches in diameter and 6 inches high. The measurements are the same as a ¾-inch angle valve. The trap is especially useful on vacuum heating and vapor systems on the gravity plan and in circulating exhaust steam with a vacuum pump on the return pipe. It is said to give the same results as live steam. The device is listed at $2.00.

New Books

Johnson's Handy Manual, for plumbers and steamfitters, 5th edition, by John W. Johnson, 4x6 3-4 inches. Pages, 202. Price, $1.00. Chicago, Ill.: John W. Johnson, 802 Stewart Building.

This book is divided almost equally between the subjects of steam heating and plumbing. In that part devoted to heating and ventilation, the writer presents many details of installations as designed by himself, together with much standard information and tables which he has made use of in his own practice and has found trustworthy. Among the many interesting designs in this book is



DESIGN FOR CROSS-CONNECTED PUMPS, SHOWING BATTERY BOILER, PUMPS, FEED WATER HEATER AND TANK ON THE ROOF

one for cross connected pumps, which is reproduced herewith. The illustration shows a battery boiler with cross connected pumps, feed water heater and tank on the roof. The installation is made as follows: Connect pumps No. 1 and No. 2, as in illustration, by 4x3 inch tees to the city main. Between the tees and pump connections, insert gate valve *A* and *B* and flange unions. Valve must in all cases be next to the tee, so that in case either pump should have to be disconnected, valves *A* or *B* can be closed and the pump disconnected without interfering with the water supply.

From the tee, connecting pump No. 1, run a 4" pipe to a point directly under the roof tank and with a long sweep elbow continue the pipe up through the roof and connect to the bottom of the tank on this pipe, marked 4" tank suction on the illustration, at a convenient place, insert a 4x2" tee and connect with 2" pipe, marked "feed to boiler through heater," using valve *C* and flange union. When feed from tank direct to boilers close valve *D* and open *C*. When feed which has passed through the heater is wanted close valve *C* and open valve *D*. Check valve *E E* must be set to open with the flow of water from tank or heater.

Pump Discharge.—When pumping to roof tank close valves *F* and *G* and open valves *H* and *I*. Check valve *J* must be set to open with the flow of water to the tank.

If direct feed from pump No. 1 to boiler is wanted proceed as follows:

Close valves *H*, *G* and *L* and open valves *F* and *M*. The flow will open check valve *E* and close check valve *E E*. If direct feed from pump No. 2 to boiler is wanted, close valves *I*, *F* and *L* and open valves *G* and *M*. Check valves *E* and *E E* have the same action as when pump No. 1 is used.

Feed to Heater.—When using pump No. 1 to supply water to heater, close valves *H*, *G* and *M* and open valves *F* and *L*. When pump No. 2 is used, close valves *L*, *F* and *M* and open valves *G* and *L*.

The figure being an elevation to show all pipes, valves and unions, the position of the pipes is necessarily somewhat distorted.

TRADE AND MISCELLANEOUS NOTES

Trade Literature

Sargent Steam Meter, a device for indicating the pounds of steam flowing through it, irrespective of the pressure, is illustrated and described in a booklet published by the Sargent Steam Meter Company, Chicago, Ill. The meter shows at a glance the quantity of steam being used by an engine, steam pump heating system or drying room. The booklet also describes the Sargent Indicating Angle Meter and the Sargent Draft Gage.

H. W. Johns-Manville Co, New York, publishes leaflets describing the Victor combination meter, a direct reading instrument giving volts, amperes, watts and horse-power simultaneously. This is the only electrical meter giving a simultaneous reading of these items on one dial. The meters are made in three types, the list prices ranging from $28.00 to $475.00. The H. W. Johns-Manville Company also announces the Manville Fire Extinguisher, which is a dry chemical extinguisher, put up in metal tubes, 22 inches long and 2 inches in diameter. It weighs three pounds and is listed at $3.00 each or $30.00 a dozen. A special size, 12 inches long, is made for automobiles and sells for $2.50 each or $25.00 a dozen. Renewed attention is called to the Portland Sectional Conduits, manufactured by this firm, for protecting and insulating underground pipes. Some interesting reports have been made of tests of underground pipe at Andover, Mass., which show the high efficiency of this type of insulation.

American Radiator Co., Chicago, Ill., issues a new catalogue describing the Ideal Water Heaters for use in providing hot faucet water, tempering water (to take out chill, prevent freezing or for heating service), heating enclosures (by radiation) and flat iron heating (auxiliary to laundry heaters). Numerous illustrations show the use of hot

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water heaters in heating and providing hot water for laundries, barns, conservatories, barber shops, stables, roof water tanks and trolley stations. A sectional view of a residence is shown containing a hot air furnace, equipped with an Ideal Auxiliary water heater, located within the furnace, using an outfit of four American radiators, stationed in the exposed and distant rooms. The catalogue concludes with numerous sectional and other views of the various types of heaters, together with a table showing the capacities of the 20 forms and sizes made by the company, also the list prices. Pages 48. Size, 7¾x10¾ inches.

High Duty Metal, an account of the researches and experiments leading to its discovery, is the title of a booklet just issued by the Western Tube Company, Kewanee, Ill., regarding its new discovery in bronze mixture. "It is a well-known fact," says a writer, "that the copper alloys, known as brass and bronze, generally suffer a marked reduction in strength with increase of temperature. This loss of strength is not generally taken into account, because the deterioration is slow up to a certain point and this point is above the temperature of steam or air at the usual pressures. At about the temperature of 150 to 175 pounds steam, the loss begins to be very rapid and at about 400 degrees Fahrenheit there is a sudden marked drop in tenacity. From that point to 500 degrees Fahrenheit, the loss is very rapid and the strength of the material is seriously affected." In an exhaustive series of tests, it has been found "that an alloy that is very commonly in use as steam metal, and would be called a fairly good metal for this purpose, showed a drop in tensile strength of as much as 28 per cent. when raised to the temperature of 407 degrees Fahrenheit, which is about the temperature of steam under 250 pounds pressure without superheating. It was assumed that this temperature would be a fair one at which to make these tests, inasmuch as engineering practice is tending strongly in these days to the use of steam at about this pressure, or superheated from a lower pressure to this temperature.

"Another metal which has been considered an excellent mixture and is frequently used by valve makers for valves of higher grade and designed for higher pressure, showed 22 per cent. loss under the same conditions.

"The well-known 'government' mixture, as it has been called, consisting of 88 parts of copper, 10 of tin and 2 of zinc, was found to be as little affected by this extraordinary increase of temperature as any alloy which has ever been used, as far as known, in the manufacture of valves. The 'government' mixture was found to have as an average

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of a large number of bars tested, a cold tensile strength of 33,633 pounds per square inch. When raised to 407 degrees Fahrenheit and again tested, the temperature being maintained constant during the test, the tensile strength dropped to 30,675 pounds per square inch, showing a loss of nearly 9 per cent.

"We are glad to say that after making all of our experiments, we have arrived at an alloy which is practically of the same tensile strength as the above mixture when cold, as it shows an ultimate strength of 33,520 pounds per square inch at 70 degrees Fahrenheit, and further, it shows an ultimate strength of 31,627 pounds per square inch at 407 degrees Fahrenheit, the loss being only 5.6 per cent.

"A table is appended which shows in summarized form the results of these experiments upon six different alloys, as follows:

Alloy.	Tensile Strength at 70° F.	Tensile Strength at 407° F.	Loss Per Cent.
No. 1	21,790	15,640	28.2
No. 2	29,010	22,410	22.4
No. 3	24,510	22,059	9.5
No. 4	33,633	30,675	8.8
No. 5	33,710	31,305	7.1
No. 6	33,520	31,627	5.6

"No. 1 is the steam metal alluded to above and which is in common use among valve manufacturers.

"No. 2 is a metal which we ourselves use at times and is fairly strong and durable at comparatively low temperatures.

"No. 3 represents one of our earlier experiments illustrating the advance along the line of research, but indicates too low tensile strength.

"No. 4 is the 'government' mixture, so called.

"No. 5 is one of our later attempts, and No. 6 is the mixture which has finally been adopted and will be called by us 'High Duty' Metal."

In general, we believe that we have discovered a ametal whose name is expressive of its substantial merit, and that its use marks a long step in advance in valve construction.

Miscellaneous Notes

Consolidated Engineering Co., Chicago, Ill., is notifying the trade of a patent recently issued to Byron E. Van Auken for radiator valves. The claims of this patent cover all forms of valves for the discharge of air and water of condensation from radiators by differential pressure, which have a float chamber, a float for governing the discharge of water from said chamber, a water seal

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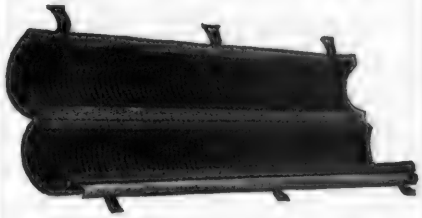
FOR HEATING SYSTEMS



Composed solely of Asbestos. Greatly increases the efficiency of a plant and **decreases the fuel consumption fully one-half.**

The corrugations run around the pipe instead of lengthwise and block all air circulation and prevent radiation.

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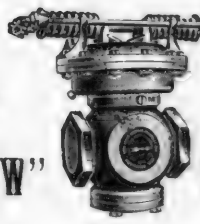
The Foster "Class W"  High Pressure Regulator

will automatically maintain a fixed lower delivery pressure in spite of the variations delivered to it through the high pressure inlet.

This valve is very effective and above all, positively reliable.

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between the radiators and the float chamber and, also, means to discharge the air which passes the water seal. All owners of heating plants and contractors for the installation of same, where vacuum valves are intended to be used, as well as the manufacturers of such valves, are warned to avoid liability of infringement on this patent.

New York University, Washington Square, N. Y., announces a special one-year course in business management for the coming year, 1906-07. The classes will meet four evenings a week. Among the studies that will be taken up are panics and depressions, advertising, principles of accounting, business organization and statistics, industrial chemistry.

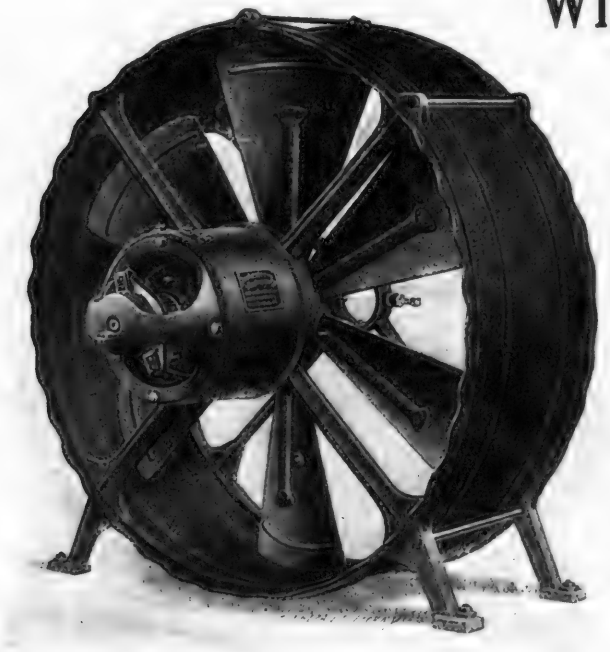
Manufacturers' Notes

H. W. Johns-Manville Co., New York, reports that the fire at the firm's Brooklyn plant on the evening of August 30 was much exaggerated by the newspapers, and that the damage was comparatively small. The fire has not in any way interfered with the business of the company, as the department affected was in operation by noon of the following day.

Albany Steam Trap Co., Albany, N. Y., is building a new 4-story building, 40x80 feet, at 317-319 North Pearl street, which will be the future home of the company. The new building will have 14,000 square feet of floor space and will be fully equipped in every detail. The present quarters of the company have been purchased by the New York Central Railroad, the site being needed for additional track room.

Standard Steam Specialty Co., New York, is sending out a report in connection with the installation of the Utility Exhaust Muffler, Oil Separator, Return Tank and Pump Governor, which contains much convincing evidence of the efficiency and durability of this apparatus. The installation in question was in one of the large down-town office buildings and the report says: "The Utility was installed in this building nearly four years ago and it has never been opened or cleaned. We have two Babcock and Wilcox boilers and as we give our tenants service twenty four hours every day, we can only open them for cleaning at the close of each heating season. We have just finished our boiler cleaning and insurance inspection, and they are in perfect condition. There was not a trace of oil, and we have saved the cost of the "Utility" in boiler cleaning expense and have not lost a tube. By condensing the steam from both sides of separator, I know that it is doing as good work as when first put in, and believe it a good investment for any plant having exhaust steam."

Fowler & Wolfe Mfg. Co., Philadelphia, Pa., notified the trade, under



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Manufacturers of

WING'S Disc Fan and Combinations
WING'S Fans and Turbine Engines for Forced Draft, etc.
WING'S High Speed Steam Engines
WING'S Acetylene Generators, etc.

date of August 20, 1906, that on and after September 1, the price for their wall radiation would be advanced one-half cent per foot upon all sizes. The company states this notification is necessitated by the greatly increased cost of material.

United States Radiator Co., Buffalo, N. Y., has sent out cards announcing the withdrawal of quotations on radiators. The card also states that higher prices will go into effect.

American Radiator Co., Chicago, Ill., has engaged Ambrose Down to take charge of the southeastern New York territory.

Peterson Heat, Light & Power Co., Marshalltown, Pa., is installing a central heating plant.

National Pipe Bending Co., New Haven, Conn., has let the contract for a new foundry 25x65 feet and 18 feet high.

H. H. Ritter, New York, has resigned his office with Francis Bros. & Jellett and has become treasurer of the Roberts Filter Mfg. Company, of Philadelphia.

McCrum-Howell Co., New York, has received the contract for the radiation in the new temporary station of the New York Central Railroad in New York.

New Corporations

Virginia Plumbing & Heating Co., Richmond, Va., has been incorporated for $10,000.

Wells & Newton Co., New York, has been incorporated with a capital of $70,000. The incorporators are: J. L. Wells, Amityville; J. A. McQuillen, Passaic, N. J.; C. P. Newton, W. G. Cornell and W. H. McKeiver, New York.

Rich & Lightburn Mfg. Co , Memphis, Tenn., has been incorporated with a capital of $30,000 to manufacture valves. The incorporators are: George W. Rich, J. S. Lightburn, Gwynne Yerger, Charles C. Campbell and S. B. Anderson.

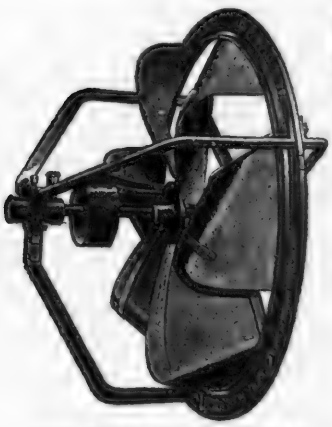
Frankfort Heating Co., Frankfort, N. Y., has been incorporated with a capital of $100,000. The directors are: George W. Neal, R. P. Shanklin, George L. Thompson, W. P. Sidwell, John A. Ross, Joseph P. Palmer, George T. Dinwiddie, James A. Lucas and H. C. Sheridan. The officers are: President and general manager, George W. Neal; vice-president, R. P. Shanklin; secretary and treasurer, George L. Thompson.

Lacey & Co., Washington, D. C., has been incorporated with a capital of $5,000 to carry on a general heating and plumbing business. The incorporators are: Charles C. Lacey, John D. Leonard and William L. Ford.

Lyon Plumbing & Heating Co., Columbus, Ohio, has been incorporated with a capital of $10.000 to carry on a general heating and plumbing business.

Paul System Co., Boston, Mass., has been incorporated with a capital of $5,000. The officers are: President, Hugh B. McEachern; treasurer, James J. Irwin and secretary, Arthur M. Marston.

D. H. Williams Co., Schenectady, N. Y., has been incorporated with a capital



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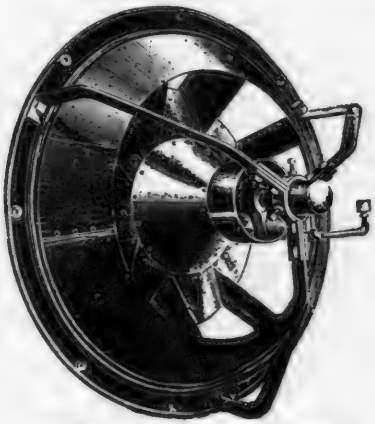

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MANUFACTURERS, ENGINEERS AND CONTRACTORS

of $15,000. The incorporators are: D. H. Williams, E. A. Williams and H. Hamell.

Relative Humidity Co., Buffalo, N. Y., has been incorporated with a capital of $100,000. The incorporators are: B. F. Herr, F. D. Riegle and H. E. Herr.

Contracts Awarded

C. H. Norton, Marinette, Mich., installing a heating plant in the Menominee Electrical Works. The consideration was about $2,996.

C. H. Turner Co., Parkersburg, W. Va., installing a low pressure heating apparatus in the new federal building.

E. D. Loos, Colby, Wis., heating and plumbing the new high school building.

Hankee & Eha, St. Paul, Minn., installing a heating plant in St. Bernard's Church.

James H. Merritt & Co., New York, installing $110,000 heating system in the New York Central railroad at West Albany.

Powell & Droste, Anderson, Ind., steam heating the First Methodist church parsonage.

American District Steam Co., Lockport, N. Y., installing underground heating system in Dayton, Ohio, for the Dayton Citizens' Electric Company.

J. M. Rinkes, Anderson, Ind., heating the county infirmary at his bid of $1,250.

Lamoy & Shelley, Saranac Lake, N. Y., heating and ventilating the new school house at Dannemora.

Carson-Payson Co., Danville, Ill., heating a school building at Watseka, Ill.

Eddy Engineering Co., Alpena, Mich., heating the Obed Smith and the Jefferson school building. The bids, respectively, were $1,230 and $1,535.

Mouat-Squires Co., Cleveland, Ohio, remodeling the heating and ventilating plant of the Chandler & Rudd Company; also heating the new shops being built for the Warner & Swasey Company.

George E. Sheerer, Waterloo, Ia., heating the Harlan school at Oelwein. The contract price was $1,840.

Roberts Plumbing Co., Marion, Ia., heating and plumbing Odd Fellows' Home in Mason City.

Central Plumbing & Heating Co., Peoria, Ill., plumbing and heating the new residence of C. B. King. Their bid was $4,000.

Frank Turner, Pittsfield, Ill., steam heating the Pittsfield House; also installing a hot water heater in E. D. Glandon's house.

Blumve & Jay, Los Angeles, Cal., in-

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Send for booklet 17 H, with a list of distinguished patients permanently cured.

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CAMDEN, N. J.

stalling a steam heating plant in a three-story and basement brick building for F. M. Brown, at their bid of $6,550.

L. H. Pender, Norfolk, Va., steam heating the new Methodist church.

George A. Kees, St. Paul, Minn., heating a new school building at Bisbee, N. D.

Lucas & Deible, Reynoldsville, Pa., heating and plumbing the new Peoples' National Bank building.

George L. Grennall, Jefferson, Ia., plumbing and heating the new hotel in Rockwell City.

Leibelt Iron Works, Grand Rapids, Mich., installing a new heating plant in the county house.

Shaw & Co., Minneapolis, Minn., hot water heating the following residences: J. W. Mercer, J. V. Johnson and W. C. Sinclair.

Smith & Meadows, Oconomowoc, Wis., heating the city hall, at their bid of $1,800.

S. D. Bryce, Bluffton, Ind., installing new steam heating system in the Columbian school building. The consideration was $2,545.

Metal Construction Co., Des Moines, Ia., heating the Flynn block.

George Unger, Hardware Co., Lebanon, Pa., steam heating the Ratdorf Building.

Gaylord & Eitapenc, Binghamton, N. Y., heating the Academy at Oxford.

Fargo Plubing & Heating Co., Fargo, N. D., heating a new school building at Fessenden.

McAllister & Crabtree, Flandreau, S. D., steam heating the court house.

Miller-Kane Co., Wilkinsburg, Pa., heating a $22,000 apartment house for T. B. McAbee.

Mankato Mfg. Co., Mankato, Minn., heating the new Immanuel Hospital.

Libbv & Blinn, Hartford, Conn., steam heating the New Britain National Bank Building, New Britain, Conn.

James Leck, Minneapolis, Minn., erecting a sixty-foot circular hot water reservoir at Casselton, N. D., for the Great Northern Railway.

Columbus Heating Co., Wheeling, W. Va., installing a heating apparatus in the

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new addition to Edington Lane school house.

D. K. Allen, Greenwich, Conn., plumbing and steam heating A. P. Fitch's new $20,000 house.

U. S. Johnson, Tama, Ia., steam heating the Carnegie Library.

J. Lynn Hobson, Bristol, Tenn., installing the heating apparatus in the new Third Ward school at Bristol, Va.

Kemp Bros., Paxton, Ill., installing a steam heating plant in the north end of the east side school building.

Bradley & Chatham, Boston, Mass., heating the club house being built for the Tarratine Club at Bangor, Me.

A. L. Vrooman & Son, Spokane, Wash., plumbing and heating the agricultural building of the State University, Moscow, Idaho.

Lestershire Plumbing & Heating Co., Lestershire, N. Y., heating and plumbing the new high school.

Blomkun Electric Co., Milwaukee, Wis., installing a central heating and lighting plant in the almshouse and county hospital. The contract is worth $18,040.

James Tucker & Sons Co., Monson, Mass., heating the building for women at the Massachusetts Hospital for epileptics. The consideration is $7,620.

P. C. Thomas, Ithaca, Mich., steam heating the school house.

A. E. Vesper, Passadena, Cal., installing a Webster vacuum system for heating, also plumbing in the Hotel Wentworth.

James Foley, Leavenworth, Kan., steam heating the postoffice building, at his bid of $2,747.

Watson Brothers, Marinette, Mich., installing the heating plant in the county jail. The contract is worth $3,295.

Sheridan & Chapman, Goshen, Ind., heating and plumbing the annex to Hotel Hascall.

R. J. Mercer & Co., Traverse City, Mich., heating, plumbing and lighting the new Hotel Gragory at Fife Lake; also steam heating the public schools of Fife Lake. The contracts amount to $3,500.

Johnson Service Co., Milwaukee, Wis., installing temperature regulating system in the new $5,000 000 palace of King Alfonso of Spain. The amount of the contract is about $15,000. The firm will send its own men to Spain to install the apparatus.

P. Gormly, Philadelphia, Pa., installing heating plants in the following buildings: Boys' Club of Nicetown, cost, $1,900; the Carnegie Library, cost, $7,000; C. H. Clark's residence, cost, $700; the Free Library, cost, $2,600; the Women's Homeopathic Hospital, cost, $5,500; and

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Lewis & Kitchen, Kansas City, Mo., heating, ventilating and heat regulation system in the Clay school at Sheffield.

W. R. Johnson, Havelock, Neb., heating the High School.

Iron City Heating Co., Pittsburg, Pa., heating the Osceola Public School.

Engelby Bros., Roanoke, Va., installing heating systems in the Belmont school; Masonic Building and Jeter school at Bedford City; and Randolph-Macon College at Port Royal.

Buffalo Forge Co., Buffalo, N. Y., installing forced draft equipment for the Bethlehem Steel Company, consisting of six fans and engines (direct connected) and other accessories, including dampers, speed regulating valves, piping, ducts, etc. The company reports the contract as secured solely on the engineering merits of the apparatus offered several other companies submitting proposals with lower bids. This company has also the contract for the heating and ventilating equipment in the addition to the machine and boiler shops of the Philadelphia and Reading Railroad. The contract includes six immense fans, heaters, tempering coils and piping. The heaters are arranged for use with atmospheric pressure steam in connection with the Webster Vacuum System. The fans are to be belt driven from electric motors, "silent chains" having been tried on other fans and proving not satisfactory.

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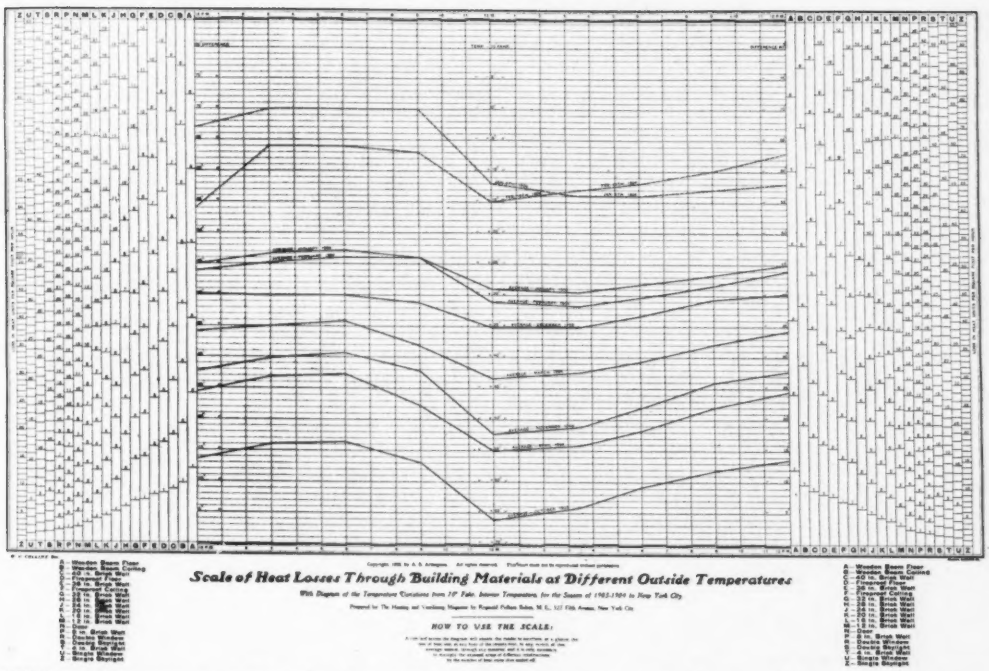

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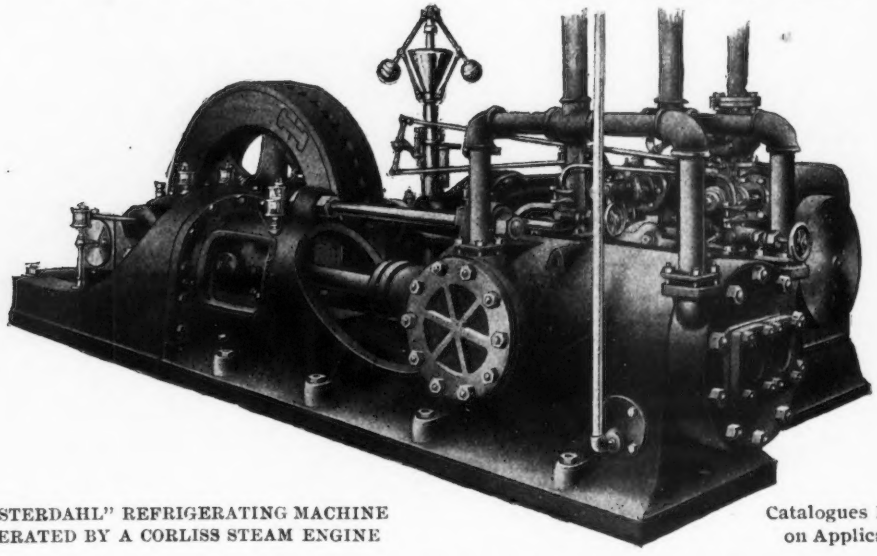

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